Course of Study

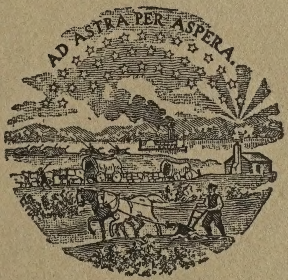
for the

High Schools of Kansas.

Prepared by

The State Board of Education,

1908.



STATE PRINTING OFFICE,
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COURSES OF STUDY FOR HIGH SCHOOLS.

Section 1 of chapter 387, Session Laws of 1905, reads in part as follows:

"The State Board of Education shall prescribe the course of study for the normal institutes, and for the public schools of the state, and shall revise the same when the interests of the schools require it."

The State Board of Education, acting under authority of the law as quoted above, has attempted to prepare courses of study that shall, in some degree at least, meet the needs of the high schools of Kansas. We believe that these courses are sufficiently elastic to serve the purpose of practically every high school in the state. Recognizing the ideal held before the young people of the state by our institutions of higher learning we have outlined the college preparatory course, following very closely the work heretofore outlined in the University High School Manual. But we believe that the high schools are essentially the schools of the people, and not primarily preparatory schools for institutions of higher grade. We have therefore thought it feasible to so differentiate the courses that our young people may have in our high schools the greatest opportunity possible to fit themselves for the work they must do when they leave the high school. With this thought in mind we have outlined the general and normal courses.

Let us, so far as possible, fit for college and university. Let us give the young men and the young women who must enter the business world immediately upon graduation from the high school the best preparation possible.

Let us also train the still greater number of young men and young women who will teach school immediately upon graduation in the art and science of school management.

We have thus sought to meet the need, as far as possible, of the great throng of young people who are crowding into our high schools. Our hope is that these efforts will meet

the approval of school boards, superintendents and principals generally.

If these courses, with live, enthusiastic teachers behind them, meet the demand of the young people—if, in Prof. John Dewey's words, "they remove friction, free activity, economize effort, make for richer results"—it is well, and we have accomplished our purpose.

In addition to the courses offered there will be found a somewhat elaborate definition of the units of work in the several studies. The value of any high school to a community depends upon the kind and character of the work done. We cannot urge too strongly upon high-school authorities not to place any subject upon the program unless there be ample provision for the successful teaching of that subject.

We also strongly urge that all high schools offer at least two courses. Whether two, three or four years' work be offered should depend entirely upon the teaching force in the high school. We fear that a number of high schools in this state are attempting too much, in view of the number of teachers. We believe that not more than three years in any course should be offered when there are not more than two instructors to do the work.

The Board has been at great pains to so arrange the courses as to make them correspond, as closely as conditions in this state will permit, with the best modern thought in regard to the rational and orderly development of the curriculum.

We trust that this labor of the State Board of Education will be of real service to the high schools of Kansas.

COURSES OF STUDY FOR HIGH SCHOOLS,

AS AGREED UPON BY THE STATE BOARD OF EDUCATION AT THE REGULAR MEETING OF JANUARY 28-30, 1908.

COLLEGE PREPARATORY COURSE.

The subjects from which college entrance work may be offered, together with the number of units, are arranged in six groups, as follows:

TABLE No. 1.

GROUP I. English, four units; three units required.

GROUP II. Mathematics, four units; two and one-half units required.
Elementary algebra, one and one-half units.
Plane geometry, one unit.
Trigonometry, one-half unit.
Solid geometry, one-half unit.
Advanced algebra, one-half unit.

(The elementary algebra and plane geometry are required.)

GROUP III. Foreign languages.
Latin, four units.
Greek, three units.
German, three units.
French, three units.

(Of these, three units are required, which must be, first, three units of Latin, or, second, three units of German.)

GROUP IV. Physical sciences, one unit required.
Physics, one unit.
Chemistry, one unit.

(Physiography may be used by schools which find it impracticable to do either physics or chemistry.)

GROUP V. Biological sciences, one unit required.
Botany, one unit.
Zoölogy, one unit.

GROUP VI. History, one unit required.
Greek and Roman, one unit.
Mediæval and modern, one unit.
English, one unit.
American, one unit.
Economics, one unit.

(If American history is taken, it should be taken in the last year of the course.)

Explanation with Reference to Standards in the College Preparatory Course.

I. Instructors who are expected to carry college preparatory work should be graduates of a university, college or four-year normal school course, and in addition to this they should have special training with reference to subject-matter and method for some special department of work. Instructors should not be required to carry more than six recitations per day.

II. The courses prescribed for entrance to the University of Kansas and to the accredited colleges of the state are estimated in terms of a unit, which consists of a subject running for at least thirty-five weeks, five recitations per week, with at least forty minutes for each recitation. In all laboratory courses the laboratory period should be twice the length of the recitation period.

III. The character and scope of each unit in any subject shall conform to the definition recommended by the University of Kansas, which is also the definition of the accredited colleges of Kansas.

The foregoing table No. 1 shows by groups the subjects that may enter into a college preparatory course in a high school, but does not give the order in which subjects may well come. It is intended that principals or superintendents shall select from the groups given above a course of study suited to their condition, taking care that all the required units are first included in proper order.

The following specific courses (tables Nos. 2 and 3) are suggested for the consideration of superintendents and principals.

TABLE No. 2.

College Preparatory Course for High Schools Having Three or More Teachers.

FIRST YEAR.

FIRST TERM.	SECOND TERM.
English.	English.
Algebra.	Algebra.
Latin or German.	Latin or German.
Greek and Roman history.	Greek and Roman history.

SECOND YEAR.

FIRST TERM.	SECOND TERM.
English.	English.
Geometry.	Geometry.
Latin or German.	Latin or German.
Botany.	Botany.

THIRD YEAR.

FIRST TERM.	SECOND TERM.
English.	English.
Algebra.	Select a half unit from table No. 1.
Latin or German.	Latin or German.
Mediæval and modern history.	Mediæval and modern history.

FOURTH YEAR.

FIRST TERM.	SECOND TERM.
Physics.	Physics.
American history.	American history.
Latin.	Latin.
Select one subject from table No. 1.	Select one subject from table No. 1.

In the above course (table No. 2) the following eight and one-half units are specifically required, as will be seen by examining the subjects

by groups in table No. 1: One and one-half units of algebra; one unit of plane geometry; three units of English; three units of either Latin or German.

Besides these, one unit is required from each of groups IV, V, VI, which subject in the group is taken being left to the superintendent and principal.

Fifteen units are required for full entrance to the University of Kansas, which is the standard for all accredited colleges. Taking the eight and one-half specified units and the three units by groups from the fifteen required units, leaves three and one-half units to be selected from the other subjects in the groups. These can be taken at the pleasure of the principal and superintendent. For instance, only one unit of history is required, but there are three units in the course in table No. 2. Two of these history units could be replaced by other subjects in table No. 1, or English history could be put in the place of American history, etc. In the same way, in the second year, zoölogy could be put in the place of botany. Likewise, in the fourth year, where one subject is to be selected from table No. 1, it may be either chemistry or physics. In the third year, second term, the half unit which is to be selected from table No. 1 may be any one of half units given there, or any half unit which local conditions make advisable, but in the latter case the half unit would not be counted for admission to the University or the colleges.

There are, as will be seen in table No. 2, sixteen units in a four-year course, while but fifteen are required for entrance to the University or the accredited colleges. This leaves one unit which may be filled in with subjects that local needs may indicate.

TABLE No. 3.

College Preparatory Course for High Schools Having Two Teachers.

FIRST YEAR.

FIRST TERM.	SECOND TERM.
English.	English.
Latin or German.	Latin or German.
Algebra.	Algebra.
Greek and Roman history.	Greek and Roman history.

SECOND YEAR.

FIRST TERM.	SECOND TERM.
English.	English.
Geometry.	Geometry.
Latin or German.	Latin or German.
Botany.	Botany.

THIRD YEAR.

FIRST TERM.	SECOND TERM.
English.	English.
Algebra.	Select one-half unit.
Latin or German.	Latin or German.
Physics.	Physics.

A school of two teachers cannot, under ordinary circumstances, do more than the twelve units necessary for conditional admission to the University or the accredited colleges. These twelve units make three full years of work. In case a school is so fortunate as to be able by alternation of classes to do more than twelve units, an additional unit or two may be carried, provided the teachers do not have more than six periods of teaching per day, that being fixed by the action of the State Board of Education as the maximum. (See page 6.)

For instance, in table No. 3, botany is given in the second year. Suppose that for the next class zoölogy is given. Those who took botany the year before would now be in the third year, and by taking five subjects they could take zoölogy with the class in the second year. They

would thus have made thirteen units instead of twelve. In like manner, in the place of physics in the third year chemistry might be given, and taken by the second-year class. This alternation, however, involves five subjects in some years, which would prove a heavy burden. Therefore schools that are equipped with but two teachers are advised to enter upon alternation of subjects only after very mature deliberation.

GENERAL COURSE.

The subjects for the general course are arranged in the following groups:

GROUP I. English, four units; three units required.

GROUP II. Mathematics, four units; two and one-half units required.
Algebra, one and one-half units.
Geometry, one and one-half units.
Advanced algebra, one-half unit.
Trigonometry, one-half unit.
(The elementary algebra and plane geometry are required.)

GROUP III. Modern Languages.
German, three units.
French, three units.
Spanish, three units.

GROUP IV. Physical Science, two and one-half units; one unit required.
Physics, one unit.
Chemistry, one unit.
Physiography, one-half unit.

GROUP V. Biological Science, two and one-half units; one unit required.
Botany, one unit.
Zoölogy, one unit.
Physiology, one-half unit.

GROUP VI. History, four and one-half units; two units required, one of which shall be American history.
Greek and Roman, one unit.
Mediæval and modern, one unit.
English, one unit.
American, one unit.
Civics, one-half unit.

GROUP VII. Commercial, four units.
Bookkeeping and business practice, one unit.
Commercial law, one-half unit.
Commercial geography, one-half unit.
Stenography, one unit.
Typewriting, one-half unit.
Business arithmetic, one-half unit.

GROUP VIII. Economic, five units.
Economics, one unit.
Agriculture, one unit.
Manual training, one unit.
Domestic science, one unit.
Free-hand and mechanical drawing, one unit.

GENERAL COURSE.

Suggestive Course of Study for High Schools of Three Teachers.

FIRST YEAR.

FIRST TERM.

Required:
- English.
- Algebra.

Elective:
- Physiography.
- History.
- Modern languages.
- Manual training, or
- Domestic science.
- Drawing.

SECOND TERM.

Required:
- English.
- Algebra.

Elective:
- Physiology.
- History.
- Modern languages.
- Manual training, or
- Domestic science.
- Drawing.

SECOND YEAR.

FIRST TERM.

Required:
- English.
- Botany.
- Geometry.

Elective:
- History.
- Modern languages.
- Commercial geography.
- Manual training, or
- Domestic science.

SECOND TERM.

Required:
- English.
- Botany.
- Geometry.

Elective:
- History.
- Modern languages.
- Business arithmetic.
- Manual training, or
- Domestic science.

THIRD YEAR.

FIRST TERM.

Required:
- English.
- Algebra.
- History.

Elective:
- Zoölogy.
- Modern languages.
- Agriculture.
- Bookkeeping.

SECOND TERM.

Required:
- English.
- History.

Elective:
- Zoölogy.
- Modern languages.
- Agriculture.
- Bookkeeping.
- Geometry.

FOURTH YEAR.

FIRST TERM.

Required:
- American history.
- Physics.

Elective:
- English.
- Advanced algebra.
- Modern languages.
- Economics.
- Commercial law.
- Stenography.
- Civics.
- Chemistry.
- Reviews, common branches.

SECOND TERM.

Required:
- American history.
- Physics.

Elective:
- English.
- Trigonometry.
- Modern languages.
- Economics.
- Stenography.
- Typewriting.
- Chemistry.
- Reviews, common branches.

Suggestive Course of Study for High Schools of Two Teachers.

FIRST YEAR.

FIRST TERM.

Required:
English.
Algebra.
History.

Elective:
Physiography.
Modern languages.
Manual training, or
Domestic science.
Drawing.

SECOND TERM.

Required:
English.
Algebra.
History.

Elective:
Physiology.
Modern languages.
Manual training, or
Domestic science.
Drawing.

SECOND YEAR.

FIRST TERM.

Required:
English.
Geometry.
Botany.

Elective:
History.
Modern languages.
Commercial geography.
Manual training, or
Domestic science.

SECOND TERM.

Required:
English.
Geometry.
Botany.

Elective:
History.
Modern languages.
Business arithmetic.
Manual training, or
Domestic science.

THIRD YEAR.

FIRST TERM.

Required:
English.
Physics.
American history.
Algebra.

SECOND TERM.

Required:
English.
Physics.
American history.

Elective:
Civics.
Geometry.
Reviews, common branches.

NORMAL COURSE.

The subjects for the normal high-school course are arranged in the following groups:

GROUP I. English, four units; three units required.

GROUP II. Mathematics, four and one-half units; two and one-half units required.
Algebra, one and one-half units.
Geometry, one and one-half units.
Arithmetic, one-half unit.
Advanced algebra, one-half unit.
Trigonometry, one-half unit.

GROUP III. Foreign languages.
Latin, four units.
German, three units.

GROUP IV. Physical science, two and one-half units; one unit required.
- Physics, one unit.
- Chemistry, one unit.
- Physiography, one-half unit.

GROUP V. Biological science, two and one-half units; one unit required.
- Botany, one unit.
- Zoölogy, one unit.
- Physiology, one-half unit.

GROUP VI. History, four and one-half units; two units required, one of which shall be American history (including Kansas history.)
- Greek and Roman, one unit.
- Mediæval and modern, one unit.
- English, one unit.
- American (including Kansas), one unit.
- Civics, one-half unit.

GROUP VII. Commercial, four units.
- Bookkeeping and business practice, one unit.
- Commercial law, one-half unit.
- Commercial geography, one-half unit.
- Stenography, one unit.
- Typewriting, one-half unit.
- Business arithmetic, one-half unit.

GROUP VIII. Arts, four units; one unit required.
- Manual training, one unit.
- Domestic science, one unit.
- Free-hand and mechanical drawing, one unit.
- Music, one unit.

GROUP IX. Pedagogy, two units; both required.
- Psychology, one-half unit.
- Methods and management, one-half unit.
- Reviews of common branches, one unit.

NORMAL COURSE.

Suggestive Course of Study for High Schools of Three or More Teachers.

FIRST YEAR.

FIRST TERM.	SECOND TERM.
Required:	*Required:*
English.	English.
Algebra.	Algebra.
Elective:	*Elective:*
History.	History.
Foreign languages.	Foreign languages.
Manual training, or	Manual training, or
Domestic science.	Domestic science.
Drawing or music.	Drawing or music.
Physiography.	Physiology.

SECOND YEAR.

FIRST TERM.

Required:
- English.
- Botany.
- Geometry.

Elective:
- History.
- Foreign languages.
- Commercial geography.
- Manual training, or
- Domestic science.

SECOND TERM.

Required:
- English.
- Botany.
- Geometry.

Elective:
- History.
- Foreign languages.
- Business arithmetic.
- Manual training, or
- Domestic science.

THIRD YEAR.

FIRST TERM.

Required:
- English.
- Algebra.
- Psychology.

Elective:
- History.
- Foreign languages.
- Zoölogy.
- Bookkeeping.

SECOND TERM.

Required:
- English.
- Methods and management.

Elective:
- History.
- Foreign languages.
- Zoölogy.
- Bookkeeping.
- Arithmetic.

FOURTH YEAR.

FIRST TERM.

Required:
- American history.
- Physics.

Elective:
- English.
- Foreign languages.
- Commercial law.
- Chemistry.
- Stenography.
- Civics.
- Reviews.

SECOND TERM.

Required:
- American history.
- Physics.

Elective:
- English.
- Foreign languages.
- Typewriting.
- Chemistry.
- Stenography.
- Reviews.

UNITS IN THE FOREGOING COURSES DEFINED.

In order that teachers may understand clearly what each unit in the foregoing groups and courses ought to cover, the units are defined in detail in the following list.

Group I.

ENGLISH. *Three units.*

The requirements in English for admission to the University of Kansas—requirements that are now standard for all American colleges—as formally stated comprise only English literature, meaning classics chiefly, and English composition. As originally formulated, these requirements were defined by stating as follows the nature of the examination to be based upon them:

"I. READING.—A certain number of books will be set for reading (see list subjoined). The candidate will be required to present evidence of general knowledge of the subject-matter, and to answer simple questions on the lives of the authors. The form of examination will usually be the writing of a paragraph or two on each of several topics to be chosen by the candidate from a considerable number—perhaps ten or fifteen—set before him in an examination paper. The treatment of these topics is designed to test the candidate's power of clear and accurate expression, and will call for only a general knowledge of the substance of the books. In place of a part or the whole of this test, the candidate may present an exercise book, properly certified by his instructor, containing compositions or other written work done in connection with the reading of the book. In preparation for this part of the requirement, it is important that the candidate shall have been instructed in the fundamental principles of rhetoric.

"II. STUDY AND PRACTICE.—This part of the examination presupposes the thorough study of each of the works named in this division. The examination will be upon subject-matter, form, and structure. In addition, the candidate will be required to answer questions involving the essentials of English grammar, and on the leading facts of the periods of English history to which the prescribed texts belong.

"*Note.*—No candidate will be accepted in English whose work is notably defective in point of spelling, punctuation, idiom, or division into paragraphs."

Since the adoption of the requirements thus indicated, supplementary recommendations have been made from time to time with intent to make clearer the real meaning and intent of those requirements. Among the first of these supplementary recommendations was the following group:

1. That English be studied throughout the primary and secondary school courses, and when possible for at least three periods a week during the four years of the high-school course.

2. That the prescribed books be regarded as a basis for such wider courses of English study as the schools may arrange for themselves.

3. That where careful instruction in idiomatic English translation is not given, supplementary work to secure an equivalent training in dictation and in sentence-structure be offered throughout the high-school course.

4. That a certain amount of outside reading, chiefly of poetry, fiction, biography, and history, be encouraged throughout the entire school course.

5. That definite instruction be given in the choice of words, in the structure of sentences and of paragraphs, and in the simple forms of

narration, description, exposition, and argument. Such instruction should begin early in the high-school course.

6. That systematic training in speaking and writing English be given throughout the entire school course. That in the high school, subjects for compositions be taken partly from the prescribed books and partly from the student's own thought and experience.

7. That each of the books prescribed for study be taught with reference to: (*a*) The language, including the meaning of words and sentences, the important qualities of style, and the important allusions. (*b*) The plan of the work, *i. e.*, its structure and method. (*c*) The place of the work in literary history, the circumstances of its production, and the life of its author. (*d*) That all details be studied, not as ends in themselves, but as means to the comprehension of the whole.

To these recommendations a paragraph on grammar has since been added:

The student should have a sufficient knowledge of English grammar to enable him at need to point out the syntactical structure of any sentence which he encounters in the prescribed reading. He should also be able to state intelligently the leading grammatical principles when he is called upon to do so. Whether this knowledge is obtained in the elementary school and the secondary school combined, or only in the elementary school, is immaterial, provided the student have it; but in most cases it cannot be acquired except through regular study and practice in the lower grades, and scarce through these. A progressive and regular development of the grammar sense, from the lowest grades to the highest, is much to be preferred to a sudden and unprepared for injection of formal grammar at a particular stage, as, for example, in the eighth grade.

With reference to the teaching of composition, teachers have been advised in still other recommendations that composition work should be oral as well as written, that such work should be continuous throughout the entire high-school course, and that text-books in rhetoric or composition are by no means essential to successful training, but are to be used with great discretion. Other suggestions have been that the studies of composition and of classics be correlated throughout the high-school course in the proportion of about three recitation periods weekly of classics to two periods of composition, and that the length of the English course indicated be three years of five recitation periods weekly.

The classics recommended for the examination occurring in September of 1909, 1910 and 1911 are as follows:

FOR READING.

GROUP I (two books to be selected):
- Shakspere—As You Like It.
- " —Julius Cæsar.
- " —The Merchant of Venice.
- " —Twelfth Night.
- " —Henry V.

GROUP II (one book to be selected):
- Bunyan—The Pilgrim's Progress, part I.
- Bacon—Essays.
- Addison—De Coverley Papers ("Spectator").
- Franklin—Autobiography.

GROUP III (one book to be selected):
- Chaucer—Prologue.
- Spenser—Selections from Færie Queene.
- Pope—The Rape of the Lock.
- Goldsmith—The Deserted Village.
- Palgrave—Golden Treasury (first series), books II and III, with especial attention to Dryden, Collins, Gray, Cowper, and Burns.

GROUP IV (two books to be selected):
Hawthorne—The House of the Seven Gables.
Thackeray—Henry Esmond.
George Eliot—Silas Marner.
Dickens—A Tale of Two Cities.
Scott—Ivanhoe.
" —Quentin Durward.
Goldsmith—The Vicar of Wakefield.
Mrs. Gaskell—Cranford.
Blackmore—Lorna Doone.

GROUP V (two books to be selected):
Emerson—Essays (selected).
Ruskin—Sesame and Lilies.
Irving—Sketch Book.
Carlyle—Heroes and Hero-worship.
De Quincey—Joan of Arc and the English Mail-coach.
Lamb—Essays of Elia.

GROUP VI (two books to be selected):
Palgrave—Golden Treasury (first series), book IV, with especial attention to Wordsworth, Keats, and Shelley.
Coleridge—The Ancient Mariner.
Lowell—The Vision of Sir Launfal.
Scott—The Lady of the Lake.
Poe—Poems.
Tennyson—Gareth and Lynette, Lancelot and Elaine, and The Passing of Arthur.
Arnold—Sohrab and Rustum.
Byron—Mazeppa and The Prisoner of Chillon.
Longfellow—Courtship of Miles Standish.
Browning—Cavalier Tunes, The Lost Leader, How They Brought the Good News from Ghent to Aix, Evelyn Hope, Home Thoughts from Abroad, Home Thoughts from the Sea, Incident of the French Camp, The Boy and the Angel, One Word More, Herve Riel, Pheidippides.
Macaulay—Lays of Ancient Rome.

FOR STUDY AND PRACTICE.

Shakspere—Macbeth.
Milton—Lycidas, Comus, L'Allegro, and Il Penseroso.
Burke—Speech on Conciliation with America.
Macaulay—Life of Johnson.

ALTERNATIVES.

FOR BURKE:
Washington—Farewell Address; and also
Webster—First Bunker Hill Oration.

FOR MACAULAY:
Carlyle—Essay on Burns.

Within the indicated limits, the choice of the books to be read, their arrangement, and the order of study, are left to the teacher, and must vary with circumstances. In a general way, it may be advisable to undertake to study later writers before earlier ones, American before English, prose before verse, narrative and concrete literary types before those that are reflective and abstract. But since all these principles cannot be applied at once, any combination of them will serve that, under the conditions of each case, seems to be the order of increasing interest and of easiest approach to difficulties, and will at the same time coördinate the study of classics with that of composition. The only text-books needed, except for reviewing the history of the periods concerned, are editions of the classics themselves; and the reading of them should be accompanied with such discussion as will best serve to aid students to appreciate the form, style and spirit of the books read, as well as to un-

derstand their subject-matter and their general relations, historical and personal.

It will often be expedient, before taking up in class the works prescribed for careful study, to spend some time upon a part of the fiction and later verse in the home-reading list, in order to show such pupils as may need it how the home-reading and study may be carried on. To do this will be the more necessary and will take longer if the class has had no satisfactory training before entering the high school. Afterward, when this preliminary study of fiction and verse has been completed, and the pupil continues such reading outside of class while working in class on the books prescribed for careful study, the results of his outside reading should still be constantly tested by making it as often as necessary the subject of class discussions and of written reports and essays. Although not specifically mentioned in the reading list, the outside reading is always to include biographical and historical matter relating to the authors, the texts, and the periods represented.

After selecting the recommended classics, it will be found that in three years there is ample time for reference reading, and for the rapid reading of more classics than are prescribed. The dividing of the three-year course into one-year units is a matter that may be governed by circumstances or by the convenience of the teacher. The course should be viewed as a whole and taught as a whole, without other than necessary reference to years and terms. In passing from American writers to English, and from later to earlier, careful comparisons should be made at each step.

The following tentative outline includes, perhaps, the simplest of the various options offered, except that Burke's Speech on Conciliation is retained because of its peculiar value and adaptability for every sort of analysis. For all but a few of the classics named, alternatives may be substituted at pleasure from the prescribed list:

IN CLASS.	OUT OF CLASS.
	Fiction.
Hawthorne.—House of the Seven Gables. Begin in class, finish outside if necessary.	Eliot.—Silas Marner, after completing Hawthorne. Contrast American and English traits, and if possible compare the Vicar of Wakefield as an eighteenth-century novel.
	Verse.
Lowell.—Vision of Sir Launfal. Compare American with English, later with earlier. If convenient, read also The Cotter's Saturday Night before beginning Carlyle's Essay on Burns.	Coleridge.—The Ancient Mariner. Goldsmith.—Deserted Village. Reference and other collateral reading as required.
	Essay.
Carlyle.—Essay on Burns. Study for style and method as well as subject-matter, with comparisons as previously suggested.	Irving or Emerson.—Selected essays. Lamb.—Essays of Elia.
	Public Address.
Burke.—Speech on Conciliation.	Extended reference reading.
	Earlier Verse and Prose.
Milton.—Lycidas, Comus, L'Allegro and Il Penseroso.	Bunyan.— Pilgrim's Progress, Part I.
	Drama.
Shakspere.—Macbeth.	Shakspere.— Two plays selected from list.
	General historical review.

In this outline the first year's work might include Carlyle, the second Burke and Milton, and the third Shakspere and the historical review. Shakspere and Milton may, of course, be interchanged at pleasure, and the general order may be otherwise varied in any way that will best serve the general end of making the work interesting and profitable.

The preceding arrangement is such that as a rule no classic is read at home until part of it or until a similar one has been studied in class. The purpose of this is to insure a fuller appreciation of the books read at home. That the pupil may in his class-study have passed on to another type of literature, does not make any difficulty. When a classic has been assigned for home reading, a recitation period may be spent in the preliminary discussion of it, and essay subjects relating to it may then be assigned; when the home reading of it is completed at least one or two recitation periods may be spent in reviewing it, and some of the essays may then be presented in class. Whenever time presses, a longer classic, the reading of which has been begun in class, may be completed out of class, provided always that the teacher sees to it that, by means of final discussion or otherwise, the work shall be understood as a whole, and that its literary or artistic unity shall be the chief thing to be impressed on the minds of the pupils.

The class study of literature is intended to be much more thorough, and therefore much more critical, than the collateral home reading. It must be systematic, and yet no single system or method can be made to apply to all the books studied. Indeed, it might be said that if a method of study proves satisfactory with one book or class, or in the hands of one teacher, that is an excellent reason why it is likely not to be satisfactory with another book or class or teacher. Certain things, however, may be indicated as belonging in general to the critical study of literature; and in taking up the study of a classic the teacher must decide which or how many of them may profitably be applied in that instance, and must be ready to supplement them with others. Such a list of what may be called points of attack upon a classic is as follows:

A.—The meaning of the classic; interpretation and abstract; the clearing up of all difficulties of words or phrases, figures and allusions; the analysis of logical structure, the determining of important events and characters and of the central lesson or purpose of the work as a whole.

B.—The style of the classic; study of selected passages, to note distinctive peculiarities of language or structure and to determine which of them contribute to the merit of the work or throw light upon the personality of the author.

C.—The method of the classic, logical or artistic; after the interpretation is completed, deciding to what type or class of literature it belongs and developing as far as may be some of the principles upon which that classification is based.

D.—Relation of the author to the classic; the study of his purpose and motive and of his reasons for his choice of subject and of form, of his attitude toward his work, his general habit of thought, and so on.

E.—General relations of the classic, historical and literary; after the collateral reference reading is completed, study of the historical basis of the work, its place in literary development, its influence, and so on.

F.—General review and summary of whatever matters have been taken up for special study; selection of best parts and passages, and general estimate of the literary value of the work.

With a beginning class, and with some books of less importance, it might be best to confine attention to topics A and F of this list. With a class a little more advanced, and with suitable books, other topics may be introduced. A new topic of study may receive a greater proportion of time than those earlier considered; and it is necessary to be very careful not to take up too many points in the study of any one book; its central

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meaning and unity, its distinctive purpose, relations and merit, are among the chief things to be kept in view.

The correlation of the studies of composition and of classics consists not only in carrying them on side by side, but in making use of the books read to illustrate the principles of expression which students may apply to their own speech and writing, in assigning subjects which will require independent critical reading of books in hand, or reading for information on special topics, and, so far as is convenient, in keeping to the same general order of subjects in both studies, so that the work done in each may reenforce that of the other. Abstracts and summaries of books read should never be required as composition exercises except when absolutely necessary, as they hinder the growth of that independence of view which is essential in the critical study of literature. To maintain and develop ease and originality of expression, fully half of the composition exercises should be based on the student's experience; that is, on his present or past observation; and on occasion exercises may be partly or wholly imaginative.

Composition and rhetoric are not to be regarded as distinct subjects in the high-school course. A rhetoric is merely a text-book in composition; and in the study of composition, as in that of literature, the use of formal text-books is purely an incidental matter. The principal part of the work must always be the preparation and discussion of oral and written exercises. Such an exercise of some kind, longer or shorter, should be a part of every lesson, and probably at least one exercise every week should be a written exercise of some length.

Points that may be successively considered in a course in composition are: the structure of discourses, of paragraphs, and of sentences, the choice and use of words, and the nature and more general principles of narration and description, exposition and argument. Throughout the course, the most important objects to keep in view are the securing of easy and spontaneous expression, and the adapting of material to the person or public addressed. To accomplish these most successfully the work may well begin with the preparation of stories—that is, of narrative or descriptive exercises based on observation or imagination; then may follow the preparation of essays presenting reflective material derived from all sources, and the study of theme, plan, and paragraphs; then, with any sort of material or treatment, may be taken up the study of sentences and words, and the general principles of style; and finally, the general principles of all forms of discourse, and in particular of narrative and exposition, may be considered with appropriate material and exercises. Any text-book may be used, in so far as it is found to be suitable and helpful; but no text-book should be followed too closely, and no topic or exercise assigned if there is no better reason for assigning it than that it is to be found in the book.

Under no circumstances should a period be spent in memoriter recitation upon any text; if there can be no practical illustrative exercise of any kind, the study of rhetorical theory is of little worth except for such incidental aid as it may furnish toward the appreciation of literature, and this is too little for the time expended. Often the work in composition may be done to the best advantage without the use of any text or texts whatever, except for reference and in reviewing.

Any division according to years or terms of the subjects named must be discretionary, to suit the conditions of individual schools or of individual classes or teachers. The following general arrangement by years is therefore purely tentative, to be followed only when no better plan can

be found. It includes classics as well as composition, in the order already specified:

FIRST YEAR.

IN CLASS.	OUT OF CLASS.
Literature. Three periods weekly. House of Seven Gables, in part. Vision of Sir Launfal. Essay on Burns. Other books as selected.	House of Seven Gables, completed. Silas Marner. The Ancient Mariner. Deserted Village. Essays of Irving or Emerson, and Lamb. Reference-reading of biography, history, etc.

Composition and Rhetoric. Two periods weekly.
The finding, shaping and adapting of material, in written and oral exercises; stories, letters, essays, study of theme, plan, and paragraph.

SECOND YEAR.

IN CLASS.	OUT OF CLASS.
Literature. Three periods. Speech on Conciliation. Minor Poems of Milton. Other books as selected.	Reference reading. Pilgrim's Progress, part I.

Composition and Rhetoric. Two periods.
The principles of style, in written and oral exercises; stories, letters, essays, study of sentence-structure and of choice and use of words, study of paragraphs, translation, synonyms, figures, verse forms, etc.

THIRD YEAR.

IN CLASS.	OUT OF CLASS.
Literature. Three periods. Macbeth. Other books as selected. General historical review.	Two selected plays of Shakspere. Reference reading.

Composition and Rhetoric. Two periods.
The forms of discourse; stories, letters, essays, study of nature and principles of narration and description, exposition and argument.

To secure the continuous study of English through the four years of a high school either of two methods may be followed. If practicable, it is of advantage for all students, and particularly for such as do not afterward enter college, to add a fourth year of English to the three full years herein described as a college-entrance requirement. If this is not practicable, the three years' work may be distributed through four years by assigning to it fewer than five recitation periods a week in the last two years, so that the total time given it is not increased.

An excellent four-year course in English may be made by simply arranging for the reading of a greater number of the classics listed as alternatives for 1909, 1910, and 1911, with some few additions, as here shown. Year divisions cannot be prescribed, though they may correspond roughly to the successive centuries as indicated. The composition work for the first three years may be as indicated in the preceding table; for the fourth year it may consist of regular essay writing.

FOUR-YEAR ENGLISH COURSE.

NINETEENTH CENTURY.

American Fiction; the short story.

(This part of the course may be given in the grades.)

IN CLASS.	OUT OF CLASS.
Selections from Irving.—The Sketch-book.	Selections from Hawthorne.—Twice Told Tales. Poe.—Tales.

American and English Fiction; longer works compared with short stories.

(Part of this work may be done in the grades.)

Hawthorne. — House of Seven Gables begun. One book selected from Eliot, Scott, Dickens, Gaskell, or Blackmore (see list).	Hawthorne. — House of Seven Gables completed. The remaining books listed from Eliot, Scott, Dickens, Gaskell, and Blackmore.

American Verse.

(Books interchangeable at pleasure.)

Lowell.—Vision of Sir Launfal.	Longfellow. — Courtship of Miles Standish. Poe.—Poems.

English Verse, compared with American.

(Books interchangeable at pleasure, and so below.)

IN CLASS.	OUT OF CLASS.
Coleridge.—Ancient Mariner.	Books listed from Scott, Byron, Tennyson, Browning, Arnold, Palgrave's Golden Treasury.

American Essay.

Selections from Emerson.	Selections from Irving and Holmes.

English Essay.

Carlyle.—Essay on Burns.	Books listed from Lamb, Ruskin, Carlyle, DeQuincey.

EIGHTEENTH CENTURY.

Fiction.

Goldsmith. — Vicar of Wakefield, begun.	Goldsmith. — Vicar of Wakefield, completed. Johnson.—Rasselas. DeFoe.—Robinson Crusoe. Selections from Gulliver's Travels.

Verse.

Goldsmith.—Deserted Village.	Books listed from Pope, Macaulay, and Palgrave's Golden Treasury.

General Prose.

Burke.—Speech on Conciliation. Macaulay.—Life of Johnson.	Addison. — Papers from "Spectator." Franklin.—Autobiography.

SEVENTEENTH CENTURY.

Verse.

Milton.—Minor Poems.	Milton.—Selections from Paradise Lost. Selections from Palgrave's Golden Treasury.

Drama.

Shakspere.—Macbeth.	Shakspere. — Two or more plays selected from list.

Prose.

Bacon.—Selected Essays. Selections from King James's Bible, *e. g.*, the Book of Job. (May be taken from Modern Reader's Bible.)	Bunyan.—Pilgrim's Progress. Bible Selections, *e. g.*, Psalms, Proverbs, Lamentations, Ecclesiastes. (Modern Reader's Bible.)

EARLIER LITERATURE.

IN CLASS.	OUT OF CLASS.
Chaucer.—Prologue.	Chaucer.—Selections from Canterbury Tales.
Spenser. — Selections from Færie Queene.	Spenser. — Selections from Færie Queene.
	Selections from Old English, in translation.

Historical review.

Students who offer, with the approval of the High-school Visitor, the equivalent of this four-year course in English for entrance to the University, may be excused from taking in the University the English literature course of the Freshman year, which is otherwise required for admission to any other University courses in English.

At option any high school may add to the regular three-year course in English a fourth year of either English language or English composition, and have the same accepted as one of the fifteen required entrance units. A one-year course in English language may begin with the study of elementary Old English—grammar, prose composition, and readings from the simplest prose and verse. Then may follow the history of the English language and grammar after the Old English period, with particular attention to orthography, pronunciation, word composition and derivation, inflections and syntax; and the course may be completed with the study of Middle English for the rest of the available time. Good text-books for such a course as this are Smith's Old English Grammar for the Old English part, Champney's History of English or Emerson's History of English for the historical part; and for the study of Middle English either or both of Sweet's First and Second Middle English Primers, or the school editions of Chaucer's Prologue to the Canterbury Tales, and the Knightes Tales.

In a year of English composition to follow the regular three-year course the time may be given chiefly to the study of the principal forms of discourse, narrative and descriptive, expository and argumentative, with daily practice in adapting these to all purposes and occasions for which speaking or writing is demanded, with especial reference to purpose and occasion and to the character of the person or public to be addressed. With this there should be a large amount of collateral study of literary selections illustrating the several types of oral and written address as they are taken up for study and practice.

To be accepted by the University, a four-year course in English, or a fourth year of English, must have the approval of the University High-school Visitor; and if accepted, students who offer it will be excused from a corresponding part of their college English. Entrance certificates must show in complete detail the nature of the high-school English course, and especially of the fourth unit, if offered.

If any course herein outlined seems too heavy, it may be lightened by omission, or by having some part of the earlier work done in the grades. In any case, whether three or four years in length, the high-school English course is to be planned and taught as an integral thing, and not as a series of detached one-year units. It is to be taught without reliance upon any particular text-book, and with regard for results rather than methods. The University and the business world alike wish to have high-school pupils trained to see and think for themselves in the study of books as well as of nature and of men; and trained to express what they see and think with readiness, ease, and reasonable accuracy. Whatever books or methods lead most efficiently to these general ends may reasonably be approved; and exact uniformity in courses or in the work of individual teachers, or in the work of the same teacher in successive years, is neither prescribed or expected.

The number of good text- and reference-books in English is now so great that it is scarcely practicable to specify any one as being the best of its class. Editions of the classics listed in the requirements for college

entrance may be had of any educational publisher. Among the good text-books in composition and rhetoric are those of Genung, Newcomer, Webster, Mead and Gordy, Scott and Denney, Lockwood and Emerson, Smith and Thomas, Herrick and Damon (revised edition), Gardiner and Kittredge and Arnold, Kavanagh and Beatty, Espenshade, Huntingdon, and Lamont. A convenient little reference-book on methods of teaching classics is Heydrick's How to Study Literature. The most complete treatise yet published on methods of teaching English subjects in general is Carpenter, Baker and Scott's The Teaching of English.

The paper edition of the University Handbook on the Teaching of English, which has for some years been sent free to applicants on payment of postage, is now exhausted. A few copies bound in cloth remain in the hands of the publishers, Scott, Foresman & Co., and will be sent postpaid for fifty cents each as long as they last.

The University theme and essay tablet for use in composition teaching, with any text-book or without a text-book, is published by O. P. Barnes, 378 Wabash avenue, Chicago, and is sold for fifteen cents.

New editions of classics and new texts and references in all English subjects are constantly appearing, and the best way to choose is to select from publishers' catalogues those which appear to be most suitable, and to write for copies for examination with the privilege of return. All educational publishers extend this privilege to teachers and school officers.

Group II.

MATHEMATICS. *Three units.*

The requirement in mathematics for admission to the College of Arts and Sciences, School of Law, School of Fine Arts, and School of Medicine of the University of Kansas, consists of one and one-half units of elementary algebra, and one unit of plane geometry. In the School of Engineering, an additional half-unit of solid geometry is required.

An additional half-unit of plane trigonometry and a half-unit of advanced algebra will be accepted by the University from such of its accredited schools as the High-school Visitor may certify are properly equipped to teach these courses.

Detailed accounts of the topics required and the suggestions as to the methods of teaching the various subjects are given below.

ELEMENTARY ALGEBRA. *One and one-half units.*

The text-book in Algebra adopted for the use of the Kansas schools is Marsh's Elementary Algebra. Since this book contains a larger amount of algebra than the average class can master in a year and a half under present conditions, some portions of it must be omitted, and it becomes necessary for the University to specify definitely just what portions may be omitted and just what portions must be mastered by the pupils in order to fulfill its requirements for admission.

The task is most easily accomplished by enumerating the paragraphs, exercises and chapters which may be omitted, and yet the pupils be fully prepared to enter the University classes. In this way the University lays down the essential things and the minimum amount of algebra which the preparatory schools must teach, but leaves them free to select such other topics as their time and local conditions may permit. But it is recommended that the high schools omit these designated topics and chapters from their course, and drill their pupils more thoroughly in the required topics.

These omissions and other suggestions are given in the following notes on the various chapters. Chapters not mentioned are to be taken entire, but no comments on them are deemed advisable.

Chap. I. Note.—This chapter is very easy, but no part of it ought to be omitted for that reason. Exercises I, II, III, and IV, especially, should be given careful attention.

Chap. IV. Note 1.—In this chapter, solve every problem and check the result. Less attention should be given to the axioms than to the process of verification, because the latter is the only certain test of the correctness of a solution. It should be made clear to the pupil that the solution of a simple equation means the finding of a value of the unknown which will satisfy that equation. Too often pupils have the notion that it means going mechanically through a certain regular process which at the end gives the "answer." As Professor Heppel says: "A habit of constant verification cannot be too soon encouraged, and the earlier it is acquired the more swiftly and almost automatically it is practiced."*

Note 2.—Chapters I, II, III and IV are so elementary in their character and so suitable for younger pupils that they may well be taught in the grammar-school. The practical use and the disciplinary value of the methods of chapter IV are worth more to the pupil than all the compound

*Heppel, Algebra in Schools, in the Mathematical Gazette, February, 1905.

proportion, bank discount, cube root, etc., that are contained between the covers of the old arithmetics. The notion that all problems in the schools and in school examinations should be "solved by arithmetic" is inexcusable pedantry.

Chap. V. Note.—In solving examples 4 to 9, inclusive, of exercise XXX, the use of parentheses in the first expansion, as illustrated in the type example just above the exercise, should be insisted upon.

Chap. VI. Note 1.—This chapter on factoring is of fundamental importance and should be thoroughly learned.

Note 2.—In connection with the factor theorem the solution of equations of higher degree than the first by means of factoring might well be introduced. One or two lessons devoted to such work would be profitable and would compensate the effort by added interest. Exercise CXIII, page 272, could be used at this point. Care should be taken to select only such equations as have all the roots real.

Chap. VII. Note 1.—This chapter contains two distinct methods for finding the highest common factor, and two corresponding methods for lowest common multiple. Case I, viz., the method by factoring, is the only one that the ordinary student of mathematics will ever be called upon to use in his subsequent work. This method is easy, and should be mastered.

Note 2.—The method given in articles 102 to 105 is out of place in a course in elementary algebra, for the following reasons:

(1) The proof of the method is too abstract and difficult for beginners, and is practically never mastered by them. Its proper place is in advanced courses of mathematics, in the University.

(2) The pupil does not need it in his subsequent work, and may pursue the science of mathematics to the end of his university course and never have occasion to use it except on artificial problems manufactured especially for the occasion.

Note 3.—Omit articles 102-105, exercise L, and article 109, exercise LII.

Chap. VIII. Note 1.—Omit example 3 of section 112, and examples 23-25 of exercise LIII.

Note 2.—Omit page 137, examples 12-15 of exercise LXII, and examples 27-37 of exercise LXIII.

Chap. IX. Note.—Omit articles 136 and 137.

Chap. X. Note 1.—For the work in graphs, paper ruled in quarter-inch squares and sold usually in local stores at five cents for a "Student's Note Book" of about fifty pages, will be found very satisfactory.

Note 2.—In teaching graphs the idea of locus should be emphasized. The pupil should learn to think of the graph as the path of a moving point which is restricted in its movement by the law stated in the given equation. In the development of the subject this is accomplished by making use of many questions similar to the following: "If a point be free to move except for the restriction that its x-coordinate shall always be equal to zero, where can it go?" "If a point be free to move except for the restriction that its y-coordinate shall always be equal to one, where can it go?" "If a point be free to move except for the restriction that its x-coordinate shall always be equal to its y-coordinate, where can it go?" etc. By means of such questions the pupil is led to conceive of the graphs of the equations $x=0$, $y=1$, $x-y=0$, etc., as *lines of indefinite length*—a concept that is not so readily obtained in any other way. Again, emphasis of the locus idea gives the pupil power in seeing the relations of variables and the relative changes brought about by changes in the variables.

Chap. XIII. Note.—Do not spend much time on this chapter.

Chap. XIV. Note 1.—Special attention should be given to the binomial theorem contained in articles 172 and 173. Solve all of the examples in exercise LXXXVII. In solving these examples insist upon the

use of parantheses in the first expansion as illustrated in the type form given above the exercise.

Note 2.—Omit articles 179 and 180. Special attention should be given to the finding of arithmetic square root, but no time should be wasted in introducing any work in cube root. The pupil will find out later that arithmetic roots higher than the second can be found much more easily by the use of logarithms.

Chap. XV. Note 1.—Omit examples 22-27 of exercise CIII, all of article 202, and examples 42 and 44 of exercise CVI.

Note 2.—In connection with exercise CV, it should be impressed upon the mind of the pupil that the new equation obtained by squaring or cubing the two members of a given equation will, in general, have roots that do not satisfy the given equation, and that, therefore, the checking of every solution is imperative. The author has wisely pointed this out on page 245 and in example 2, on page 246, and it is deserving of emphasis.

Chap. XVIII. Note 1.—Observe that emphasis is again laid upon the check in solving irrational quadratic equations.

Note 2.—The method of factoring should be presented early, in order to show the character of the problem and the existence of the two roots. The pupil should clearly understand that relatively few simple problems are solvable by the method of factoring.

Note 3.—In order to avoid confusion of methods, it is best that the beginner be taught but one method of completing the square of a quadratic equation. Experience has shown that the method of completing the square after dividing through by the coefficient of x^2 is the easiest for the pupil to remember. This method should therefore be taught, to the exclusion of all others.

Note 4.—After the pupil has been thoroughly drilled in the above-mentioned method of completing the square, he should be taught the formula of article 225. He should be convinced by numerous examples that the quickest way to solve a quadratic equation is to use the formula. The pupil should habitually use the formula in his subsequent work whenever he has a quadratic equation to solve.

Note 5.—The clear understanding gained by the use of graphs more than compensates for the time required to learn the graphical method.

Chap. XIX. Note.—Omit articles 245, 246, 247 and 249, but be careful not to omit article 248.

Chap. XX. Note.—Solve every problem in this chapter except those (if any) which necessitate a knowledge of the articles omitted from the preceding chapter.

Chap. XXI. Note.—This chapter should be read in connection with pages 90-97 of book III of Phillips and Fisher's Geometry.

Chap. XXII. Note.—Omit articles 262, 265 and 270.

Chap. XXIII. Note.—Omit the entire chapter.

Chap. XXIV. Note.—If time permits, make use of examples 1-21 of exercise CXLV for practice. If not, omit the entire chapter.

Chap. XXV. Note.—Omit the entire chapter. This chapter should be studied in connection with the course in trigonometry.

PLANE GEOMETRY. *One unit.*

The text-book in geometry adopted for use in the high schools of Kansas is Phillips and Fisher's Elements of Geometry, abridged edition. This text-book is so small and the number of exercises so limited, that all the book contains on plane geometry can easily be completed in one school year. Some schools and teachers will doubtless be able to complete books I-VI in one year, leaving books VII-IX to be completed in another half-year. The miscellaneous exercises on pages 333 and 334 should be taken in connection with the specific books they are intended

to supplement, and not left until the end of the course. Exercises XLIX and LI (page 336) are not well suited to this grade of work and should be omitted.

One of the chief difficulties with which both teachers and pupils have to contend in the ordinary course in high-school geometry is that the pupils are called upon to acquire at one and the same time the elementary ideas of geometry, the terminology of geometry, and a knowledge of the nature and meaning of a logical proof. This difficulty would be largely overcome if these tasks were separated, so that the pupil could acquire his geometric ideas and vocabulary a year or more in advance of his undertaking the study of demonstrative geometry.

CONCRETE GEOMETRY IN THE GRADES. As long ago as 1892 the Committee of Ten, influenced by the mathematical curriculum of the schools of continental Europe, recommended that systematic instruction in concrete (intuitional, non-demonstrative) geometry be given in the grammar grades. (See the Report of the Committee of Ten.)

Besides the above-mentioned difficulty in the teaching of the ordinary course in high-school geometry, there are weighty reasons for the introduction of some elementary geometry in the grammar grades. A very large percentage of the children in these grades never reach the high school. From their ranks is largely recruited the army of mechanics and skilled laborers of all kinds. A knowledge of the simpler facts of geometry is extremely useful in after-life to large numbers of people of this class. The public-school system should therefore be adapted to their needs and they should be given an opportunity to acquire in their school days this useful knowledge.

Concrete geometry is in its nature less abstract than many of the arithmetical theories usually taught in these grades, and is therefore better suited to the immature minds of the pupils than the more difficult processes of analysis which make up so large a part of the course in arithmetic.

It may be objected that the above suggestions are innovations which are contrary to the traditional course in geometry in American and English schools; but the experience of continental Europe has established its practicability so thoroughly that its superiority to the common method cannot be denied. The same thing is being done in many schools in this country with absolute success.

A few words on the various methods of introducing this study into the grammar grades.

BLOCKS AND MODELS. Mensuration is not the last topic that should be taken up in the course in arithmetic, but work on this subject should be carried on throughout the seventh and eighth grades. A good set of geometrical blocks and models can be used here with great profit to the pupils. Such a set can be purchased for a small amount. (One of the best sets on the market is sold by W. D. Ross, Fremont, Ohio, for $12.)

The amount of geometrical knowledge to be acquired from such a set of blocks, or from the subject of mensuration illustrated by blocks, is a good preparation for high-school or demonstrative geometry.

GEOMETRICAL DRAWING. Closely connected with concrete geometry on the one hand, and on the other associated with the manual-training idea, is the subject of geometrical drawing. This might be taken up in connection with the work in free-hand drawing or in manual training. All the essentials of the course in concrete geometry advocated above might be given in a course in geometrical drawing.

The necessary outfit is very simple; the pupil should provide himself with a pair of compasses, a ruler, a protractor, and a small drawing-board. The following sample outfit will be found very satisfactory.

The Eagle compasses, No. 569, price twenty-five cents.

A hardwood ruler with inches and fractions on one edge and centimeters on the other edge, five cents.

A German silver protractor, twenty-five cents; paper ones, thirty cents a dozen.

The Springfield drawing kit, thirty cents. (Western agents, Hoover Bros., Kansas City.)

Pupils soon acquire dexterity in the use of these simple tools, and through their proper use soon accumulate a large fund of useful geometrical knowledge.

PROBLEMS OF CONSTRUCTION. These tools should be used in connection with the ordinary course in high-school geometry, no matter whether the pupils have previously learned their use or not. Every problem of construction in Phillips and Fisher's geometry should be carefully drawn on suitable paper, and as accurately as the tools at hand will permit. With the simple outfit described above a very high degree of accuracy may be obtained. It is not enough for the pupil to learn the theory of geometrical construction; he should also be taught how to apply the theory to actual practice. For example, it is not sufficient that the pupil be able to *tell* how to construct a square equivalent to the sum of two given squares, but he should be able to do it, and do it accurately and neatly. The accuracy of the result should be verified, whenever possible, by actual measurement. In the chemical or physical laboratory it is not regarded as sufficient that the pupils are able to tell how to do a certain thing; they must be able to do it. It should be the same in geometry.

TEXT-BOOKS IN ELEMENTARY GEOMETRY. There are a number of textbooks in concrete geometry on the market intended for the use of pupils in the grammar grades; a few of these are mentioned here. These books may be obtained from the publishers. Baker's Elementary Geometry, Ginn & Co.; Nichol's Introductory Geometry, Longmans, Green & Co.; Hornbrook's Concrete Geometry, American Book Company; Campbell's Observational Geometry, American Book Company; Dodd and Chace, Elements of Algebra and Geometry, Kimberly Publishing Company, Kansas City, Mo.; Hailmann's Constructive Form Work, P. C. Burchard & Co., Boston, Mass.

The last one mentioned is the best for young children in the lower grades. Baker's little book is one of the best of its kind for more advanced pupils, and is well adapted for the upper grammar grades of the first year of the high school.

SOLID GEOMETRY. *One-half unit.*

Solid geometry, one-half unit, is required for entrance to the School of Engineering, but is not required for entrance to the College of Arts and Sciences. If not offered for entrance to the College, it must be taken in the Freshman year. All accredited schools teach solid geometry, and so it is recommended that, as far as possible, condidates for admission to the College offer solid geometry for entrance.

All of Phillips and Fisher's Solid Geometry, including the miscellaneous exercises at the end of the text, must be taken by the pupil in order to meet the requirements for entrance to the School of Engineering.

In connection with the course in solid geometry the use of blocks and models is urged, and accurate drawings should be strongly insisted on. In this connection it will be found useful to have the pupils construct cardboard models of as many of the solids studied as is possible. Patterns for a large number of these models are to be found in Campbell's Observational Geometry (American Book Company).

FOURTH-YEAR MATHEMATICS.

At present only a few high schools in Kansas give courses in trigonometry or college algebra. Hereafter plane trigonometry and college algebra, one-half unit each, may be offered for entrance and counted among the fifteen units required for entrance. It is expected that this privilege will stimulate most of the stronger high schools of the state to introduce these courses into their curricula. Where both are taught, trigonometry should precede college algebra.

PLANE TRIGONOMETRY. *One-half unit.*

Ashton and Marsh's Trigonometry is used at the University as the text-book for this course, and in amount of work and order of treatment the course in the high schools should conform to the plane trigonometry (pp. 1-115) of the above-named text-book, except that sections 24 to 28, inclusive, may be omitted. An equivalent amount of work taken from any standard text will be acceptable.

It is of fundamental importance that pupils obtain clear ideas of the trigonometric functions when they are presented. For that reason there should be some work with ruler and protractor at the first of the course. For example, to begin the course, develop by comparison of similar triangles the fact that in any right triangle the two acute angles and the six ratios of the sides are eight quantities so related that if any one of them is given the other seven are fixed. Pupils should then be given exercises in finding by actual measurement the ratios when an angle is given, and the angles and the other ratios when one of the ratios is given. They should next construct angles varying by five degrees from zero to ninety degrees and determine by measurement the approximate values of their trigonometric ratios. It will be found helpful to make the constructions upon squared paper. The results should be tabulated in the form of a table of natural functions and handed in for the instructor's examination. A reasonable amount of such work will be found very profitable.

It should be made clear to pupils that the use of logarithms is not *necessary* for the solution of trigonometrical problems, but that it is for convenience. They should be led to see that the use of logarithms, by substituting addition and subtraction for multiplication and division, economizes both time and labor. Problems, therefore, should be solved by use of the tables of natural functions before logarithms are introduced. The study of the theory and use of logarithms should be taken up in connection with the trigonometry at the time it is needed.

COLLEGE ALGEBRA. *One-half unit.*

The term "college algebra" in the past has stood for the most indefinite thing in the whole mathematical curriculum of American schools. The list of subjects in the various text-books on college algebra bear evidence to the same fact. The recent action of the joint committee mentioned in the University catalogue under "Entrance Requirements in Mathematics" has done much to standardize this course.

A half-unit of college algebra, to be accepted by the University, must conform as closely as possible to the outline printed in the University catalogue. The topic, *permutations and combinations*, may be omitted at the discretion of the teacher. All subjects involving infinite series should be omitted and the stress chiefly placed on complex numbers, determinants, the theory of equations, and their application.

In the solution of numerical equations, the roots should be located by means of the graph and their approximate values found by Horner's method. Sturm's theorem should not be given. The algebraic solutions of the cubic and quartic may be included if time permits, but they are not required.

GENERAL REMARKS. The modern tendency in mathematical instruction in secondary schools of the country is toward unification of the various branches of the science and its correlation with allied sciences. The teacher should always hold in mind that arithmetic, algebra and geometry are not separate sciences, but closely connected branches of one science, viz., mathematics. The arithmetic, algebra and geometry should be intermingled as intimately as possible. Many problems of algebra should be geometrical in character, and many problems in geometry should be solved by algebra. The unity and not the divergency of the science should be emphasized. In the high-school course mathematics and physics have contact at many points, or, rather, they interpenetrate

each other in many regions. Both should be taught in such a way as to emphasize this relationship.

The order in which the subjects are taught must be governed by local consideration. As matters now stand in most Kansas schools, it is believed that the best temporary arrangement is as follows:

First year.—Algebra to quadratic equations or thereabouts.

Second year.—Plane geometry.

Third year.—Algebra with required work completed, and solid geometry.

Fourth year.—Plane trigonometry and college algebra.

Group III.

FOREIGN LANGUAGES.

LATIN. *Four units.*

Either three or four of the following units may be offered:
1. The Beginner's Book.
2. Four books of Cæsar and Latin prose composition.
3. Six orations of Cicero and Latin prose composition.
4. Six books of Virgil's Æneid and Latin prose composition.

A full year must be given to each of these units. No credit is given for one or two units, unless the deficiency is made good after the student enters the University, or unless he enters with three units of German. If three units are offered, it is preferred that they be 1, 2 and 3; but 1, 2 and 4 will be accepted. No combination of Cicero and Virgil will be accepted as one unit.

THE BEGINNER'S BOOK. The all-important thing in the first year is that the pupil shall acquire a perfect knowledge of the forms of declension and conjugation. This means the ability not merely to repeat the paradigms correctly, easily, and rapidly, but to recognize instantly and certainly each case and verb form when met in isolation. Vocabulary and syntax are important, too, but they can be learned in later years, while a pupil who gets through the first year without learning the forms has little prospect of ever learning them. And no pupil who has to stop and think out or look up the identity of the forms he meets in his reading can ever read easily. There is only one way to teach this command of forms, namely, drill—drill at the first occurrance of a paradigm, drill in the regular reviews, drill at unexpected times all through the year. The teacher who cannot stand the drudgery of drills ought not to teach beginning Latin. Analysis into stems and endings may help some pupils a little, but it cannot take the place of thorough drilling. Besides the frequent repetition of paradigms, there must be many exercises in the recognition of isolated forms, given either orally or on the board. No beginner's book gives more of these exercises than are sufficient to serve as models.

In the first year the pronunciation is fixed, and it is as easy to fix a right one as a wrong one. The Roman method is of course the only one possible at present. A perfectly accurate pronunciation requires that long vowels be given twice the time given to short vowels, whether accented or not. This is contrary to English usage, and, for this reason, is so difficult that few teachers attempt it. But it is very easy to distinguish in quality between long and short vowels, especially as most preparatory books indicate the quantities; and there can be no possible excuse for permitting incorrect accents. Requiring pupils to mark the long vowels in all written work is helpful, but will have no effect if they hear and use an incorrect pronunciation. The teacher should spare no pains in perfecting his own pronunciation; and he should always read to the class the Latin words in the next day's lesson, and make sure that every pupil knows the correct pronunciation of every word before he learns it.

A good feature of the book adopted for use in the high schools of this state is the connected passages of easy Latin scattered through the book as reading lessons. Under no circumstances should these be omitted.

The transition from a beginner's book to Cæsar is difficult at best, and all the more so if the pupil has read no connected Latin in his first year.

CÆSAR. If the work of the first year has been done well, Cæsar is not too difficult an author to follow the beginner's book immediately. If Cæsar is read intelligently, he is very far from being too dull and monotonous for a year's work. Under these conditions, it is best to read, without substitution, four books of Cæsar, or selections from the entire seven books equivalent in amount to the first four. Books V-VII are more interesting than books I-IV, and the teacher who is weary of I-IV may well omit portions of them, especially I, 30-55, and substitute portions of the later books, as V, 1-24; V, 24-52; VI, 11-28; VII, 66-90. But if the teacher desires to make a partial substitution of some other author, the University will accept in place of one book of Cæsar an equivalent amount of Viri Romæ or Nepos. Any of the second-year books offer an acceptable substitute for Cæsar to schools which are not bound by the action of the Text-book Commission.

At the end of the second year the pupil should have an accurate working knowledge of all the common uses of the cases and modes. Therefore it is unavoidable that a drill on syntactical constructions should receive the chief attention during the reading of Cæsar. But if Latin prose composition is properly emphasized it will carry a large part of this burden, and will leave the class some time for getting at the contents of Cæsar's story. It is a great mistake to make nothing but a grammatical drill-book out of Cæsar.

The teacher will find it helpful to keep on his desk one of the several good editions of Cæsar.

CICERO. The six orations should include the four against Catiline and the one for the Manilian Law. The one for the Poet Archias may be recommended as the sixth. If a partial substitution is desired, Sallust's Catiline may be read instead of the Manilian Law and the sixth oration. This gives variety in the year's work and makes the setting to the Catiline speeches more vivid.

The syntactical drill cannot yet be subordinated, but it ought not to require so much time as during the second year. Pupils should make written abstracts of the speeches, so that they may get the contents of each as a whole; should be encouraged to read the Latin aloud with rhetorical emphasis; and should in every possible way be led to appreciate the fact that they are reading great speeches, not disconnected pages of Latin sentences.

VIRGIL. If the pupil has come up to the study of Virgil without a good working knowledge of declension and conjugation forms and of case and mode uses, he is to be pitied. There ought to be too much to do to permit of much grammatical drill. This is the reason why Virgil ought always to follow Cicero in the course, not precede. Opinions may differ as to whether pupils find Cicero and Virgil the more difficult, although a comparison of scholarly editions will prove that editors at least find Virgil vastly the more difficult. But while reading Cicero any teacher can find plenty of time for grammatical drill; while reading Virgil he ought not to be able to do so. And in his third year of Latin a pupil must have grammatical drill. If read in the fourth year, grammatical drill may be confined almost wholly to the period devoted to Latin prose composition.

First and foremost, the pupil should get the contents of the story. Fortunately few teachers fail to let their pupils do this in Virgil, however they may treat Cæsar and Cicero. Yet, an occasional college student will say that he does not know whether or not he has read the story of Æneas's descent to the lower world. Secondly, the pupil must learn to read Virgil metrically. This does not mean that he should be taught painfully to divide the lines into feet, giving a reason for each step, and then be left to imagine that he has thus "scanned" Virgil. He should

be taught to read the lines as smoothly and intelligently as so much English poetry; and this is no difficult feat. Only then will he feel that Virgil wrote poetry. It is not necessary to learn all the rules of quantity laid down in the grammars. If he has been taught to discriminate between long and short vowels in his usual pronunciation he will have no trouble at all. If not, Auxilia Vergiliana, a little pamphlet published by Ginn & Co., shows how a few rules, well used, will carry him through almost all lines; and an occasional reference to the vocabulary will clear up the rest. If the teacher is a convert in theory to the doctrines of Hale (as the writer is) or of Bennett, let him nevertheless begin by teaching the old-fashioned way, with an ictus on the first syllable of each foot, and no word accent. Few pupils will make music of Virgil's verse on any other plan. Thirdly, the pupils ought to learn a good deal of mythology—not theories about the origin and meanings of the gods, but the stories which form so integral a part of much of our English literature. In addition to these main topics, there are innumerable questions on matters literary and archæological which will occur to the teacher who knows the literature of his subject. Many of these will serve to interest and stimulate the pupil.

The teacher will find help in a desk copy of Knapp (Scott, Foresman & Co.) or Greenough and Kittridge (Ginn & Co.).

LATIN PROSE COMPOSITION. Although the goal in the study of Latin is the ability to read, rather than to write, the language, yet accurate reading is impossible without a good command of vocabulary, form, and syntax; and this can be acquired by no other method so surely and quickly as by the writing of Latin.

No manual of prose composition has been adopted by the Text-book Commission, and the teacher may therefore choose the one best adapted to his needs. There are two systems in vogue. Such books as Jones's Exercises in Latin Prose Composition (Scott, Foresman & Co.) and Bennett's Latin Composition (Allyn & Bacon) take up the principles of syntax in logical order, as they are given in the grammars, and give sentences which call for the practical use of these principles. Their chief purpose is to insure a systematic study and comprehension of the syntactical portion of the grammar. Such books as Daniell's New Latin Composition (Sanborn & Co.) and Moulton's Preparatory Latin Composition (Ginn & Co.) base their exercises closely on the texts of Cæsar and Cicero, so that the pupil uses the words and constructions found in the portion of the text just read. Their chief merits are that they give practice in writing connected passages as well as disconnected sentences, and they encourage the pupil to study closely the text he is reading. But these merits seem outweighed by the fact that they are necessarily less systematic in presenting the principles of syntax, although Daniell's attempts with some success to remedy this defect. If a specific recommendation is desired, our preference would be for the whole of Bennett, supplemented, if possible, by frequent exercises dictated from Daniell. This amount is not too large for the best interests of the pupil, since the more composition is emphasized the less needful it is to make mere grammatical drill-books of the Latin authors. D'Ooge's Latin Composition (Ginn & Co.) is a very successful attempt to combine the merits of the two methods.

The requirement of the University is that the equivalent of one period a week be given to composition throughout the second, third and fourth years. Individual experience must determine how this shall be divided. The most usual method, and perhaps the best, is to give it one period a week. Sometimes it is scattered out, so that a little is done every day; but this is likely to make the work too scrappy and to lead to its neglect. A few teachers spend several weeks together on composition alone, usually at the end of the year, and justify the plan on the ground that it interests the pupils more. This is no doubt true. The dislike felt by most pupils for composition is largely or wholly due to the fact that they do so little of it that it never becomes easy. But it must be remembered

that composition is practiced as an aid to reading, and this aid is lost unless the reading is carried on side by side with the writing.

If such a book as Daniell's is used, the exercise assigned should always be the one based on the portion of the text just read by the class, even if some exercises have to be omitted. To let the writing lag far behind the reading defeats the purpose of the method.

TRANSLATION. If translation is done well it is a better training in English expression than can be obtained from original composition on the part of the pupil; for in original composition he can usually avoid expressing at all any idea which he cannot express easily, while in translation he is forced to give expression to every idea of his author. There is therefore a sad waste of opportunity if the teacher allows himself to be satisfied with slipshod, slovenly translation. Yet the mistake is prevalent, for "translation English" has become a synonym for a certain kind of language which is never heard outside of the classroom except for humorous effect. It consists in part merely of the overworking of some very good words and phrases. A modern general might sometimes urge or encourage his men: Cæsar always exhorted his. We sometimes cannot do things; the ancients were always unable to do them. A worse feature of "translation English" consists of so-called "literal translations" of Latin idioms. Some teachers even require such renderings, although monstrosities like "he said himself to be about to go" are not English at all, and therefore are not translations. A good classroom translation must be good English, and should at the same time show the disposition made of each word of the original. If one quality must be sacrificed let it be the latter, and let the teacher satisfy himself by questions that the pupil understands the Latin. But the pupil cannot always make a good translation unaided, even if he understands the Latin. This is the best reason for invariably reading the review lessons. On the advance lesson he must be expected to stumble and must be helped. But on the next day he should be required to read through the lesson as smoothly and as perfectly as if he were reading so much English.

Too many teachers unconsciously have the habit of correcting translation by interjecting words and remarks while the pupil reads. If the pupil has prepared what he considers a good translation, this practice both irritates and discourages him. If he has not, it encourages him to prepare his translation in a slipshod way, trusting to hints from the teacher to carry him through. In either case, neither the pupil who recites nor the rest of the class can fit the teacher's suggestions into the pupil's translation. The pupil should always be allowed to read through, without suggestion, the portion assigned him, whether a sentence or a paragraph. The teacher should then comment on his mistakes, and finally should translate the whole properly.

SUBJECT-MATTER. A very common and very unfortunate defect in teaching is a failure to make sure that the pupil gets a good understanding of the subject-matter of the Latin authors. To take Cæsar, for example. Many pupils, many teachers even, find him dull and monotonous. No person could ever hold this opinion if he knew just what Cæsar did in each of his campaigns, and had taken the pains to study out his routes, his battle-fields, his methods, and his motives. But no history ever written would be interesting if read at the rate of half a page a day and studied solely from the point of view of his syntax. The language of Cæsar must be the main object of attention; but the pupil ought to know the story as he reads it, ought to appreciate the bearing of every new chapter on the whole, ought to trace out all the movements on the map. The failure to get such an understanding makes the author dull, makes it harder to secure an adequate translation of the passages assigned for the daily lessons, and leaves the pupil at the end of his year's work with no comprehension that he has been reading one of the world's great classics. If the average teacher feels satisfied that his pupils are getting such a knowledge of the subject-matter of the authors they are reading, he can

easily test his results by an examination question. At the end of any book of Cæsar let him ask his class, without previous warning, to write out a narrative of the campaign. To judge by what most college students remember of the contents of the preparatory authors, he will be surprised at the answers, if he gets any.

The surest and best method of giving pupils this knowledge of the subject-matter is requiring them to write out in note-books brief summaries of each day's lesson, as a part of the next day's work. This should be supplemented by brief discussions, and by questions during the daily recitations and in examinations. It goes without saying that the teacher himself must have a full comprehension of the subject-matter; and this he certainly will not have unless he makes a practice of reading at a sitting a whole campaign of Cæsar, a whole oration of Cicero, or a whole book of Virgil. He will be much helped, too, by reading one or more of the books which are mentioned later.

SIGHT-READING. Sight-reading has its value, though it has been overestimated. It is not worth doing at the expense of other things; but if there are a few minutes to spare at the end of the recitation, they may be well employed by letting the class read on into the next day's lesson without using either notes or vocabulary. This is better than taking Latin from some other source, because what is learned is fixed in the memory when the pupils read the passage again in preparation for the next day's recitation, and because it insures the attention of the whole class.

BOOKS. The following list contains a few of the books which, in our judgment, will be found most useful in the library of the high school or the teacher; the prices are quoted from the Publishers' Trade List Annual:

CÆSAR.

Holmes, Cæsar's Conquest of Gaul, Macmillan & Co., $6.50. The best discussion of the military and geographical problems in Cæsar.

Fowler, Julius Cæsar, G. P. Putnam's Sons, $1.50. Perhaps the best life of Cæsar.

Judson, Cæsar's Army, Ginn & Co., $1.

CICERO.

Boissier, Cicero and his Friends, G. P. Putnam's Sons, $1.75.

Forsyth, Life of Cicero, Charles Scribner's Sons, $2.50.

VIRGIL.

Conington, Virgil, Macmillan & Co., 3 vols., each $3.25. The best Englished edition. Volume II contains Æneid I-IV.

Conington, Virgil's Poems in Prose, Longmans, Green & Co., $2.

Dryden, Translation, several editions.

Sellar, Virgil, Oxford Press, $2.25. The best literary criticism.

Glover, Studies in Virgil, Edward Arnold, $2.25. Most helpful and suggestive.

GRAMMARS.

The teacher should have all the grammars commonly referred to, and especially Harkness' Complete Latin Grammar (1898), as a corrective to the 1881 edition adopted for use in the state.

LEXICONS.

Harpers' Latin Dictionary, American Book Company, $6.50.

Lewis, Elementary Latin Dictionary, American Book Company, $2.

White, English-Latin Dictionary, Ginn & Co., $1.50.

DICTIONARIES OF ANTIQUITIES.

Harpers' Dictionary of Classical Literature and Antiquities, American Book Company, $6 to $10.

Seyffert, Dictionary of Classical Antiquities, Macmillan & Co., $2.25. One or the other these books is almost indispensable.

ATLASES.

Ginn's Classical Atlas, Ginn & Co., $1.25 to $2.
Kiepert, Atlas Antiquus, Sanborn & Co., $2.50.
Sanborn's Classical Atlas, Sanborn & Co., $1 to $1.75.

WALL MAPS.

Kiepert, get price-list from Rand, McNally & Co. The best and most expensive. Cheaper maps are advertised by the Boston School Supply Company, but the department has not examined them.

HISTORY.

(See the department of history.)

HISTORIES OF LITERATURE.

Cruttwell, History of Roman Literature, Charles Scribner's Sons, $2.50.

Mackail, Latin Literature, Charles Scribner's Sons, $1.25. This is itself a work of literature.

MYTHOLOGY.

Gayley, Classic Myths in English Literature, Ginn & Co., $1.50.
Guerber, Myths of Greece and Rome, American Book Company, $1.50.

MISCELLANEOUS.

Bennett and Bristol, The Teaching of Latin and Greek, Longmans, Green & Co., $1.50.

Hale, Art of Reading Latin, Ginn & Co., 25 cents.

Johnston, Private Life of the Romans, Scott, Foresman & Co., $1.50.

Johnston, Teaching of Second-year Latin, Scott, Foresman & Co., free.

GREEK. *Three units.*

1. Elementary Greek. Gleason's Greek Primer or White's First Greek Book, or an equivalent. Thorough mastery of declensions and conjugations, and the main ideas of syntax. Xenophon's Anabasis begun, and twenty to thirty pages read. Goodwin's, Babbitt's or Goodell's Greek Grammar.
2. Xenophon's Anabasis continued into or through the fourth book, or an equivalent amount of other Attic prose. Review of inflections. Systematic study of syntax in the grammar. Practice in writing Greek based on the text read. Constant training in sight-reading.
3. Homer's Iliad or Odyssey, five to six books, exclusive of the Catalogue of Ships. Special attention to Homeric forms, vocabulary, and scansion. Constant practice in reading at sight. Seymour's School Iliad or Benner's Selections from Homer's Iliad. Perrin & Seymour's School Odyssey (edition with eight books). Attic prose composition once a week. Bonner's Greek Composition for schools.

SUGGESTIONS TO TEACHERS.

Special attention should be paid to the regular forms and constructions, the most common words and phrases and principles, leaving the irregular or uncommon to be learned when they occur in reading. Require a firm grasp of the essentials. Review and repeat, but not to weariness. Go slowly at first, yet aim to get results as fast as possible.

Help students to acquire a vocabulary, by grouping words when possible, by bringing out the English derivatives, by having them mark in both text and grammar words or principles especially to be learned, and then review them often. Don't allow a student to turn to his lexicon or grammar to look up a word or principle until he is sure that it is necessary. Have him, if possible, originate some device of his own to remember the meanings of words.

Go over as much as possible of the advance lesson each day. Have students pronounce and translate at sight; watch and teach or guide them

how to read, leading them to bring forth and apply meanings of words and forms and principles of syntax they have already had and know. Explain as much as necessary, but leave something for them to do.

Have students translate the words of a sentence in the order in which they stand in the original, and make good English afterwards. In reading poetry let them use a poetic order.

Use the blackboard much; let the students see what is necessary.

Yet train the ear also. Have some oral work every day. Have students pronounce aloud, and let them translate some from hearing, especially passages already translated from the book. If possible, introduce some conversational exercises, and have students learn some Greek by heart.

Require a knowledge of the geography, history and mythology needed to understand the author being read, and something of his life, time and works.

A few books that ought to be at command of students and teachers:

Lord's Classical Atlas, Boston, Sanborn, $1 to $1.75.

Botsford's History of Greece, New York, Macmillan, $1.10.

Bury's History of Greece, New York, Macmillan, $1.90.

Pennell's Ancient Greece, Boston, Allyn & Bacon, 60 cents.

Butler's Story of Athens, New York, Century Company, $2.40.

Jebb's Primer of Greek Literature, New York, Appleton, 40 cents.

Capp's Homer to Theocritus (a history of Greek literature), New York, Scribners, $1.50.

Jebb's Homer, an Introduction to the Iliad and Odyssey, Boston, Ginn, $1.12.

Goodell's Greek Lessons, New York, Holt, $1.25.

Gulik's Life of the Ancient Greeks, New York, Appleton, $1.40.

Harpers' Dictionary of Classical Literature and Antiquities, New York, Harpers, $6 to $10.

Liddell & Scott's Greek Lexicon, New York, American Book Company, $10.

Hill's Illustrations to School Classics, New York, Macmillan, $2.50.

Tarbell's History of Greek Art, New York, Macmillan, $1.

Schuchhardt's Schliemann's Excavations, New York, Macmillan, $4.

Tsoundas and Manatt's Mycenæan Age, New York, Houghton, Mifflin & Co., $6.

Mycenæan Troy, Tolman and Scoggin, New York, American Book Company, $1.

Weissenborn's Homeric Life, New York, American Book Company, $1.

Leaf and Bayfield's Iliad with notes, New York, Macmillan, 2 vols., each $1.40.

Moss's First Greek Reader, new edition, Boston, Allyn & Bacon, 70 cents.

Dickinson's Greek View of Life, London, Methuen, $1.

GERMAN. *A three years' course.*

FIRST YEAR.

TEXT-BOOKS SUGGESTED.* Carruth's Otis's German Grammar, Henry Holt & Co., New York (supplemented if desired by further exercises in Becker's Elements of German, Scott, Foresman & Co., Chicago), and Carruth's German Reader, Ginn & Co., Boston.

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* The books recently adopted by the School Text-book Commission serve only for a part of the first two years. Unfortunately the law was not drawn with a view to two- and three-year courses, and accordingly the Commission has adopted a book of exercises but no reader. Practically, every teacher of German uses a grammar and a reader in the first year. Accordingly, the course here recommended introduces the state text in grammar, makes a place for the exercise book for those who use such in addition, and outlines the work in a reader. The detailed programs of work are given only for the benefit of new teachers, though they may be found helpful to all. Of course, experienced teachers will adapt any such plan to the needs of individuals and classes. In any case, it is wise to explain in advance to the class the purpose of the work, the method to be pursued, and the general distribution of it.

OBJECTS OF FIRST YEAR'S WORK. (1) To obtain a thorough knowledge of elementary grammar with practical application to the printed and spoken language; (2) to obtain a good German pronunciation and ability to use German script with accuracy and moderate ease; (3) to acquire familiarity with a limited German vocabulary as employed both in standard German prose and in ordinary conversation; (4) to begin an acquaintance with good German literature and with German popular songs; (5) to learn to carry on conversation in very simple German on everyday topics.

DISTRIBUTION OF THE WORK. There should be a German recitation every school-day of the thirty-four working weeks of the school year. These 170 recitation periods may wisely be distributed as follows:

Introductory (talk about the language, illustrations, introducing phrases for conducting recitation in German, pronunciation, etc., lesson I of the grammar)	5	periods.
Grammar (nineteen lessons, two periods to each)	38	"
Review of grammar	18	"
Reader (sixty pages, from one-half page daily to two pages daily, including review)	44	"
Exercises (in reader or in state text, or both, including reviews)	28	"
Dictations and learning songs	22	"
Final review	15	"
Total	170	periods.

PROGRAM OF THE WORK—FIRST TERM.

First week: Introduction (lesson I)	5	periods.
Second week to fifth, inclusive: Grammar, five lessons (including VI), ten recitations, with ten more for review	20	"
Sixth week to seventeenth, inclusive: Grammar, three periods weekly first six weeks, two periods weekly last six weeks, to lesson XIII, inclusive; fourteen periods first time, sixteen on review	30	"
Reader, two periods weekly for twelve weeks, divided between reading and exercises on the reading, covering fifteen pages of Carruth's Reader	24	"
Dictations, one weekly, last six weeks	6	"
Total	85	periods.

CONDUCT OF LESSON II IN CARRUTH'S OTIS'S GRAMMAR. First recitation (after a week of introductory drill in pronunciation). Assign to the German exercise II, and in assigning read over slowly and carefully the model sentence, § 2, and the words of the vocabulary. (This practice of reading the vocabulary should be kept up for the first eight lessons.) Admonish class to read the German sentences over aloud in studying them.

Recitation.—Require the recitation of the model sentence from memory; be sure that the pupils understand the cases and their uses. Call for the statement of the grammatical facts included in the text of the lesson. Have the class recite the definite article, singly and in concert; have the declension given both downward and across; that is, by genders and by cases.

NOTE.—In connected speech the *e* of the article is slurred (see page 6 of the grammar), but in recitation of the forms the *e* should be pronounced distinctly, long before *m* and *n*, short before *r* and *s*.

The vocabulary may be read, or the German words required on giving the English; or, in case of the nouns, the pupils may be required to give the correct article with the noun when the teacher has spoken the noun alone. The class should recite the present tense of *sein* singly and in concert.

SECOND RECITATION ON LESSON II. Assign German exercise II and the writing, in German script, of one-half of exercise 2, the preparation of continuations of the specimen sentences in conversation 1, the memorizing of the *Sprichwort* and the poem *Das Glueck.* In assigning the lesson these should be pronounced by the teacher. Also a review of the forms of the definite article and present tense of *sein.*

Recitation.—Have sentences of the German exercise read by pupils in turn. The pupils may turn them into English, or simply be asked about the forms of the articles used, or both. In the first lesson, constant attention must be paid to pronunciation in reading the German sentences. It is a good exercise to read the German sentences slowly and have the pupils repeat them after the teacher. It cultivates the ear and promotes attention. Then send pupils to board to copy from their papers the sentences of exercise 2. When all are written, go over the sentences on the board and correct, asking class to suggest corrections and explaining, and requiring pupils to make corrections accordingly on their own papers. At close of recitation the teacher should take up these papers and correct them carefully, to return at the next recitation.

NOTE.—The teacher should take up and correct the papers himself for at least the first eight lessons. After that the class may be trusted to make its corrections in the class, but the papers should be taken up once a week throughout the first year.

Recite again, and have some of the pupils write on board, the definite article and the present tense of *sein.* Use conversation 1, the teacher asking the questions and requiring the pupils to reply, using the entire vocabulary to the conversation. Have the *Sprichwort* and the poem recited in concert.

LESSON III. Assign second half of English exercise 2 in lesson II, and to the German exercise of lesson III, for one recitation. In this recitation the first half of the English exercise 2 of lesson II is given back corrected.

The second recitation on lesson III will be assigned as on the second half of lesson II, that is, German exercise III and first half of English exercise 3, but in addition the pupils have been required to learn the now corrected sentences of the first half of the English exercise 2, and recite them in response to the reading of the English by the teacher. In learning these sentences pupils should copy them as corrected into a permanent exercise book. The learning and memorizing of the corrected sentences is one of the most essential features of the lesson. Thus, in every recitation there will come the correction of one-half of an English-German exercise and the recitation of one-half of the one preceding. It is important that the principles, vocabulary and paradigms of each lesson should be thoroughly learned before translating the English exercise. The translation of the English sentences should always be made a means and never an end in the study of the lesson.

The most dispensable part of the recitation is the reciting of the words of the vocabulary. When a German song is to be learned and sung, as in lessons III, VII, and IX, the memorizing may be done along with the second half of that lesson and the singing in the first part of the next recitation. The favorite songs should be sung frequently. There is no better means of rousing love for the language and fixing the vocabulary in the pupil's memory. Or the singing of the songs may take part of the period assigned to dictations.

FIRST READING LESSON. For the first reading lesson assign fourteen lines in Carruth's Reader. Read it over in German in assigning it. In recitation, have the pupil read the German sentence through first; correct him, and have him read it again before translating. Translation should always be in good idiomatic English, and as nearly literal as this will permit. Do not permit a word-for-word translation except as necessary to explain a German idiom. By all means require translation. Reading without translation should not be encouraged the first year, unless it be with extra matter. Discourage marginal and interlinear notes.

Exercises.—The exercises connected with the reader may be taken up one at a time just after the reading of the corresponding section, or all those on a given extract may be taken in connected series, or they may be postponed until the completion of the work in the reader. Whether the exercises are taken from the reader or from Becker's Elements of German, they should be written and corrected and learned as prescribed for the exercises of the grammar. In the second term, however, the class may be occasionally tested for its ability to do an exercise orally without having written it previously. But, even then, the exercises should be written out afterwards. Writing makes an exact scholar. Neatness in writing should be insisted upon. Exercises should have wide spacing and ample margins, to make room for corrections.

Dictations.—Dictations should consist of very simple German. A sentence should be read through twice, once very slowly and then at normal rate, and the pupil should be expected to fix the sentence as thus read. If the sentence is complex, the teacher will have to repeat the clauses in order. Dictations should be handed in for inspection and correction. Occasionally the pupils should be required to read aloud from their own manuscripts.

DISTRIBUTION OF THE WORK—SECOND TERM, FIRST YEAR.

Grammar (six lessons of Carruth's Otis, XIV to XIX, inclusive, including review)	16	periods.
Reader, (forty-eight to sixty pages, through *Der zerbrochene Krug* in Carruth's Reader)	32	"
Exercises (completing XXXVI in Carruth's Reader)	16	"
Dictations and songs	16	"
Review	5	"
Total	85	periods.

PROGRAM OF THE WORK—SECOND TERM, FIRST YEAR.

Reader, two periods weekly, sixteen weeks	32	periods.
Grammar, one period weekly, sixteen weeks	16	"
Exercises, one period weekly, sixteen weeks	16	"
Dictations and songs, one period weekly, sixteen weeks	16	"
Review, one week solid	5	"
Total	85	periods.

SECOND YEAR.

TEXTS. Carruth's Otis's Grammar; Carruth's Reader; Wilhelm Tell, Carruth's edition, Macmillan & Co., New York, or Palmer's edition, Holt & Co., New York, or Deering's edition, Heath & Co., Boston; for sight-reading: Hauff's *Der Zwerg Nase* (38 pp.), C. H. Kilborn, Boston, Ebner-Eschenbach's *Krambambuli* (47 pp.), American Book Company, Chicago, or Heyse's *Die Blinden* (52 pp.), Holt & Co., New York.

WORK TO BE ACCOMPLISHED. Review and completion of grammar; reading about 225 pages, with some composition exercises; practice in sight-reading.

DISTRIBUTION OF THE WORK—SECOND YEAR.

Review of grammar (lessons II to XIX)	10	periods.
Completing grammar (lessons XX to XXX)	22	"
Completing reader, forty-five pages of prose and fifteen pages of verse, selected	32	"
Composition exercises on the same	16	"
Wilhelm Tell, complete, with review	64	"
Sight-reading	16	"
Final review	10	"
Total	170	periods.

PROGRAM OF THE WORK—FIRST TERM, SECOND YEAR.

Completion of grammar, two periods weekly for eleven weeks,	22	periods.
Completion of reader, two periods weekly for eleven weeks, continuing with Wilhelm Tell, act I, five weeks daily......	47	"
Composition exercises on reader, one period weekly for eleven weeks	11	"
General review, one week solid.........................	5	"
Total	85	periods.

PROGRAM OF THE WORK—SECOND TERM, SECOND YEAR.

Review of grammar, one period weekly, sixteen weeks......	16	periods.
Completion of Wilhelm Tell, three periods weekly for sixteen weeks	48	"
Sight-reading, one period weekly for sixteen weeks.........	16	"
General review, one week solid.........................	5	"
Total	85	periods.

NOTE.—The Committee of Twelve recommends Wilhelm Tell for the intermediate course, or third year, of high-school work. For schools having a three-year course it may be well to follow this recommendation and occupy the reading time of the second year with easy prose, like that found in the reader. But high schools having only two years of German should by all means not deprive their pupils of the delight of reading this play, which invariably appeals to them.

THIRD YEAR.

TEXTS. Freytag's *Die Journalisten*, ed. Thomas, Holt & Co., ed. Toy, Heath & Co. (about 135 pages); Fouque's *Undine*, ed. v. Jagemann, Holt & Co. (about 115 pages); Heine's *Reisebilder*, ed. Van Dael, Heath & Co., ed. Burnett, Holt & Co., ed. Gregor, Ginn & Co. (about 90 pages); Riehl's *Burg Neideck*, ed. Wilson, Ginn & Co. (57 pages); Rosegger's *Waldschulmeister*, ed. Fossler, Holt & Co. (about 125 pages); Heyse's *Die Blinden, ed.* Carruth and Engel, Holt & Co. (about 50 pages); Schiller's *Balladen*, ed. Johnson, Heath & Co. (about 90 pages). Out of these a good selection would be: Freytag's *Die Journalisten*, Schiller's *Balladen*, and any one of the other books listed. If one of the longer ones, a portion may be read at sight.

WORK TO BE ACCOMPLISHED. Reading and careful translation of about 300 pages of prose and verse, with composition and conversation exercises thereon, and drill in more difficult features of grammar as illustrated by the text.

DISTRIBUTION OF THE WORK. A class should read from two or three pages daily—the lesser amount when more time is given to exercises on the text and to grammar review. Exceptional classes may be able to read 400 pages in the third year. In view of the minuteness with which programs for the earlier years have been given, it seems unnecessary to make such program for the third year.

FRENCH. *One, two or three units.*

FIRST UNIT. The elements of grammar (Fraser and Squair's French Grammar), all of part I and the irregular verbs in part II; or Grandgent's Essentials of French Grammar, through the irregular verbs, or Aldrich & Foster's Elementary French.

Great stress should be laid on pronunciation, the quality of the vowels, syllabication. To fix these principles and connect sound with spelling, brief exercises in dictation, occupying only five or ten minutes, should be introduced after the first few weeks.

As the grammars named above all offer reading material, the reader proper need not be introduced before the seventh or eighth week, at first but one or two lessons a week, then with increasing frequency as the elementary facts of the language are mastered.

This reading should cover not less than 100 pages of simple French (as in Super's Reader), and should serve a threefold purpose: Transla-

tion into good English, practice in reading aloud of French, and illustration (and hence review) of the grammatical principles set out in the rules and applied in the written exercises.

SECOND UNIT. Completion of all the lessons in the above-mentioned grammars, with suitable written exercises at least once a week. In this manner the pupil will by the end of this period have mastered all the essentials of accidence and syntax. The reading should contribute to this end; in particular, the use of modes and tenses should be repeatedly dwelt upon in connection with the reading.

More emphasis is now to be placed on dictation, and on the speaking by teacher and pupils of simple French sentences based on their reading, the teacher sometimes also reading aloud in French for translation by the pupils. The reading should comprise from 300 to 350 pages, which may be taken from the latter part of the reader and from such texts as Malot's *Sans Famille,* Daudet's Selected Stories, Erckmann-Chatrian's *Madame Therese,* Labiche's *le Voyage de M. Perrichon,* Sandeau's *Mademoiselle de la Seigliere.*

THIRD UNIT. Thorough review of grammar. Composition once a week, both formal grammar exercises and résumés and paraphrases of short portions of French stories.

Suitable composition books are: Mansun's French Syntax and Composition, and François's Advanced French Prose Composition.

Reading of 600 pages in such works as Mérimée's *Colomba*; A. France's *le Crime de Sylvestre Bonnard;* Pouvillon's *Petites Ames;* George Sand's *la Mare au diable;* Pailleron's *le Monde ou l'on s'ennuie;* Loti's *Pecheur d'Islande;* Theuriet's *Bigarreau;* Coppée's *le Pater.*

Teachers of French are advised to consult the valuable Report of the Committee of Twelve of the Modern Language Association of America.

SPANISH. *One Unit.*

1. A mastery of the outlines of grammar, including regular verbs and irregular verbs of the radical-changing classes for at least the first and second conjugations. Too much effort cannot be given to cultivating facility in pronunciation by careful oral drill in exercise work. For practical purposes the simplest interpretation of Spanish vowel-sound equivalents should be aimed at and insisted upon. Spanish-American values of *ce, ci,* and *z,* will be accepted in lieu of the Castilian usage for these sounds. Grammars suggested: Hills and Ford (Heath), first 33 lessons; or Ramsey's Spanish Grammar (Holt), first 33 lessons (except Nos. 26, 29, 30); or Garner's Spanish Grammar (American Book Company) through to syntax.

2. A reading facility offered by about 100 pages of modern Spanish, such as may be found in Fontaine's *Doce cuentos escogidos* (Jenkins) or Bransby's Spanish Reader (Heath).

Group IV.

PHYSICAL SCIENCES.

PHYSICS. *One unit.*

Physics as a subject for high-school instruction has a double advantage in that it is both mathematical and experimental. In so far as it is mathematical it furnishes a concrete field for the application of the generalization of algebra and geometry, and consequently shares with these subjects their certainty and their freedom from human bias. As an experimental science it has a great advantage in the fact that the observations made in the experiments must be vitalized with thought in order to be effective. There is in physics no mere staring at phenomena with whose appearance the observer has nothing to do, but on the contrary the things to be observed are produced by the student himself through the experiments he makes. Should the first observation not be conclusive, the experiment may be repeated until the student is satisfied that he has not only seen but understood. This form of observation offers an exceptionally fine field for self-activity of an educative nature—a field which is continually broadened by the ever-increasing laboratory facilities that are being provided in public and private high schools.

Successful teaching of physics requires both text-book work with demonstrative and laboratory work. The demonstrative and laboratory work are of the utmost importance and are often sadly neglected. The laboratory work and text-book work must each supplement the other. Without the actual performing of experiments the text-book is almost meaningless and soon forgotten.

In handling any text the teacher should feel free to omit any parts which, with the laboratory and demonstration facilities at hand, cannot be made perfectly clear. In every good text are found sets of problems. If these are sufficiently simple, they are of great use in affording an opportunity to apply and therefore fix in mind the principles learned. When the problems prove difficult it is likely not on account of any deficiency in the student's mathematical training. The terms used—ergs, dynes, kilograms, etc.—are confusingly new. The thing to do is to supply exceedingly simple problems till the student becomes familiar with the new units.

The second essential of a course in physics, the experimental part, includes, first, a set of thirty to forty experiments to be performed by the student; and second, a number of demonstrative experiments to be performed by the teacher in connection with the lecture or recitation. Just which experiments should be performed by the students and which should be left for classroom demonstration is often a hard question to decide. The rule that demonstrative experiments be qualitative and students' experiments quantitative is good, but has many exceptions.

Probably the most difficult task that confronts the physics teacher in the small high school is to start the equipment of a laboratory on small means. The first maxim is, buy for use and not for show. Buy the less expensive first. Get the necessities before the luxuries. Do not begin by the purchase of Geisler tubes and X-ray apparatus.

In offering suggestions in regard to the equipment of a laboratory, let us begin with the room itself. This should be dry, well lighted, and, if possible, with south exposure.

The room should be provided with heavy, flat-topped tables, about

thirty-two inches high. The length and breadth of these must often be adapted to the shape of the room, but, when possible, tables three feet wide and eight feet long will be found very convenient. These tables should have no iron in their construction, if possible, and the top should project at least three inches. Any good carpenter can make these tables.

If there is a good water system in the building the laboratory should be provided with a sink. If not, a wooden tank a foot deep, two feet wide, and three feet long, lined with lead or galvanized iron, will be found convenient. If the laboratory can be supplied with gas, the fixtures should hang from the ceiling directly over the tables and about four feet above them. Connections can then be made with Bunsen burners by the use of rubber tubing. If no gas can be provided, gasoline torches handled with care are the best substitute.

Cases for storing apparatus should be about fourteen inches deep, with movable shelves and glass fronts. They should be self-locking, and all open with the same key. It is to be noted that hard-rubber apparatus should be stored in a dark place. A class in physics consumes at best more of the teacher's time than one in most other branches. Everything about the laboratory should be arranged to facilitate the getting out and putting away of apparatus. Then the teacher should be expected and required to see that all tools and apparatus be locked up when not in use.

A few tools for making and repairing apparatus are an essential part of a laboratory equipment. There should be at least a small carpenter's work-bench, and at least the following tools: Vise, fine-toothed saw, small plane, brace, drills, screw-drivers, pliers, files, small claw-hammer, tinner's snips, small soldering-iron, hack-saw.

The following valuable advice for laboratory management is taken from Chute's Laboratory Manual:

"There are in use two methods of conducting laboratory work, the *separate* system and the *collective* system. Under the former the students work on different problems, the apparatus going around in rotation. It is difficult under this plan to have the students' work conform to a strictly logical order, but on the other hand it requires little or no duplication of apparatus. The collective system is the ideal one. Under it all are engaged on the same kind of work at the same time. It has this advantage over the separate system, a teacher can instruct all at once on any point demanding more than ordinary care and can give more attention to the few who may be less apt in their work. A combination of the two is probably the best for most schools, in that it avoids the duplication of expensive pieces of apparatus and permits it in the case of the less costly."

Experience has taught us that the average teacher of physics is liable to err in requiring too many experiments of his pupils. The result of such an error is not only confusing, but it permits the pupil to form careless habits in the use of apparatus; and, what is worse, leads him into the dangerous habit of being satisfied with inaccurate results. It would be far better for the teacher to select half the number of experiments, and see to it that each individual member of the class performs each experiment individually, and preserves a description of his work and its results in good readable form.

In submitting the following list of thirty experiments we have endeavored to suggest the most important problems which should be used in an elementary course in physics. Where facilities are ample and the time is longer than usual in the average school, it may be well to increase this number; unless such conditions exist, however, it would in all probability be unwise to undertake more than is expected in this outline. Any student who, with proper direction, has performed the following thirty experiments in connection with the text-book work, and who has preserved the history of each experiment in note-book form, will have accomplished all that should be expected of the average high-school student in the period of one year, and credit will be given for same at the University.

Each experiment is suggested by number, and following is given the apparatus necessary to perform it. The teacher is expected to use his own judgment in substituting other experiments when laboratory equipment or other facilities would make such change advantageous to the students.

LIST OF EXPERIMENTS.

MECHANICS.

I. Exercises in measurements.
 Meter stick or metric ruler.
 School square.
 Circular disc.

II. Weight of unit volume, *i. e.*, density.
 Any solid of regular geometric form.
 Metric ruler.
 Balances (spring balance will do).

III. Law of elasticity.
 Wooden rod a half inch square and about forty inches long.
 Two blocks to support the ends.
 Set of weights.
 Coiled spring and support.
 Metric ruler.

IV. Parallelogram of forces.
 Three spring balances.
 Paralleogram board or three quilting-frame clamps to attach balances to table.
 Some stout twine.
 Large sheet of paper.

V. Principle of moments (the lever).
 Meter stick.
 One lever holder.
 Set of weights.
 Some stout twine.

VI. Inclined plane.
 Board six inches wide and forty inches long.
 Tripod support, clamp holder and short piece of rod (to support upper end of board).
 Hall's carriage.
 Set of weights, or pieces of iron of different weights.
 Balances (spring balances will do).

VII. Volume and pressure of a gas (Boyle's law).
 Any Boyle's law apparatus.

VIII. Archimedes's principle.
 Any solid that will sink in water and whose volume can be measured, *i. e.*, cylinder or rectangular block.
 Balances (spring balances will do).
 Vessel of water.

IX. Specific gravity of a solid.
 Any solid (a small stone will do).
 Balances (spring balances will do).
 Vessel of water.

X. Specific gravity of a liquid.
 Small bottle, eight ounces.
 Balances (spring balances will do).
 Liquid to be measured.

HEAT.

XI. Linear expansion of a solid.
- Linear expansion apparatus.
- Thermometer.
- Boiler (apparatus A).
- Bunsen burner (or gasoline torch).
- Funnel.
- Rubber tubing for connections.

XII. Cubical expansion of air.
- Bunsen burner (or gasoline torch).
- Small glass tube twenty centimeters long, sealed at one end and a drop of mercury in the middle, so as to inclose a column of dry air about fifteen centimeters long.
- Boiler (apparatus A).
- Jar of ice-water.
- Thermometer.
- Metric ruler.

XIII. Specific heat.
- Vessel of boiling water.
- Lead shot (or closely wound coil of wire, or small nails).
- Boiler (apparatus A) and dipper.
- Thermometer.
- Calorimeters (after Hall and Bergen or Millikan and Gale).
- Bunsen burner (or gasoline torch).

XIV. Heat of fusion of ice.
- Cracked ice (or snow).
- Calorimeter.
- Balances (better use beam balance).
- Thermometer.

XV. Heat of vaporization of water.
- Calorimeter.
- Beam balances.
- Boiler.
- Glass trap.
- Thermometer.
- Rubber connections.

MAGNETISM AND ELECTRICITY.

XVI. Lines of force about a bar magnet.
- Six-inch bar magnet.
- Iron filings.
- Compass ten millimeters in diameter.
- Pepper-box or wide-mouthed bottle covered with cheese-cloth, to sift filings.

XVII. Simple voltaic cell.
- Student's demonstration battery.
- Mercury.
- Galvanometer.

XVIII. Polarization of battery cell.
- Student's demonstration battery.
- Porous cup for above.
- Solution of copper sulphate and solution of zinc sulphate.
- Galvanometer.
- Commutator.
- Leclanché battery cell, or dry cell.

XIX. Magnetic effect of current.
- Battery cell.
- Copper wire.
- Compass.
- Commutator.

XX. Electromotive force of batteries.
- Two similar battery cells.
- Galvanometer.
- High-resistance coil (about 1000 ohms).
- Commutator.

XXI. Resistance by substitution.
- Daniell cell (made of student's demonstration battery).
- Coil of unknown resistance.
- Commutator.
- Resistance-box (or some German silver wire, about No. 20. A foot in length of this wire may be used as a unit resistance).

XXII. Resistance by the Wheatstone bridge.
- Wheatstone bridge.
- Unknown resistance.
- Resistance-box (or German silver wire).
- D'Arsonval galvanometer.
- Commutator.
- Battery cell (Daniell's).

XXIII. Currents by induction.
- Bar magnet.
- Horseshoe magnet.
- Two circular coils, each containing 600 to 700 turns of No. 27 magnet wire.
- Iron rod to insert in coils (rod from tripod will do).
- D'Arsonval galvanometer.
- Battery of one or two cells.
- Commutator.

SOUND.

XXIV. Velocity of sound in air.
- Seconds pendulum.
- Hammer and any sonorous body.

XXV. Wave-length of sound.
- Tuning-fork of unknown rate.
- Glass tube 1½ inches in diameter and 30 to 50 inches long.
- One-holed rubber stopper to fit glass tube.
- Short piece glass tubing to insert in rubber stopper for attachment of rubber tubing.
- From three to four feet rubber tubing.
- Funnel.
- Water.

XXVI. Vibration rate of tuning-fork.
- Vibrograph and tuning-fork to fit.
- String.

LIGHT.

XXVII. Images in plane mirror.
- Mirror 1½ x 4 inches.
- Rectangular block to support mirror.
- String or rubber band.
- Pins.
- Ruler.

XXVIII. Index of refraction of glass.
- Rectangular piece of plate-glass with opposite edges ground.
- Pins.
- Ruler.

XXIX. Focal length of lens.
- Lens.
- Ruler.
- Lens holder.
- Card holder.
- White cardboard.

XXX. Size of object and image.
- Wire gauze (or piece of fly-screen).
- Lens.
- Meter stick.
- Ruler.
- Candle or lamp.
- Lens holder.
- Card holder.

LIST OF APPARATUS.

The following list of apparatus is suggested as one best suited to the small or medium-sized high schools. It contains all pieces necessary to perform the thirty experiments listed above, and will not be so expensive that the smaller schools cannot afford to purchase. The second column designates the number of pieces that should be purchased, based upon the size of the class. If only one piece of each is bought the expense will be much less, but more time will be needed for laboratory work, since only three or four pupils can use one set of apparatus at the same time. A class of twelve should require at least three sets of apparatus. It is understood of course that this does not apply to the larger and more expensive pieces.

APPARATUS.	Pieces needed.	Cat. No., C. H. Stoelting & Co., Chicago.	Cat. No., Central Scientific Company, Chicago.	Cat. No., Wm. Gaertner & Co., Chicago.
Meter stick	One for 2	74	321	H 101
Brass disc	One for 6	....	....	H 102
School square	One for 2	137	521	....
Aluminum cylinder	One for 4	964	....	H 701
Wooden rod	One for 2	551	651*a*	....
Spring and weight holder	One for 6	....	....	H 1202
Set weights	One for 4	....	....	H 203
Metric ruler, 30 cm. long	One each	82	325	....
Spring balances	One for 2	311	3867	H 401
Beam balance	One for 12	....	3816	H 202
Parallelogram board	One for 6	....	....	H 402
Knife edge support (lever holder)	One for 4	691	730	H 1501
Hall's carriage	One for 6	685	771	H 1602
Boyle's law tube	One for 6	1161	1051	*H 1001 †H 1001*a*
Mercury	2 lbs	....	....	....
Jar, any good vessel holding a qt	One for 4	....	....	....
Paraffin	2 lbs	....	....	....
Bottles, 2-oz., any kind	One for 4	....	....	....
Linear expansion apparatus	One for 6	1445	1561	H 1402
Steam-boiler and generator	One for 6	1329	1501	H 1401
Bunsen burner, gasoline torch, or large alcohol lamp	One for 2 to 4	5205	4625	....
Rubber tubing (estimated amount),	20 feet or more	....	....	....
Thermometer	One for 2	1255	1525	H 1102
Calorimeter	One for 2	1335	1589	H 1801
Glass trap	One for 12	1333	....	....
Volume coeff. of air-tube	One for 4	1359	....	*H 1302 †H 1302*a*
Bar magnet	One for 4	1802	1705	H 2502
Compass, small	One for 4	1881	1761	H 2902
Compass, good	One for 4	1891	1765	H 2601
Galvanometer frame	One for 4	....	....	H 2801
Iron filings	2 lbs	....	....	....
Demonstration cell	One for 4	2300	2110	H 2802
Porous cup	One for 4	2301	2110*a*	H 2803
Carbon, lead, iron, aluminum, electrodes	One for 4	2306 2309	2110*d-z*	H 3102
Copper sulfate	5 lbs	....	....	....
Zinc sulfate	3 lbs	....	....	....
Telegraph-key	Two for class	2688	2335	....
Telegraph sounder	Two for class	2690	2339	....
Telegraph relay	Two for class	2692	2343	....
Battery-cell telephone	Two for class	2703	2365	....
Electric call-bell	One for class	3000	2692	....
Push-button	One for 4	3081	2756	....
Pair coils for induction experiment	Pair for 6	....	....	H 3601

APPARATUS.	Pieces needed.	Cat. No., C. H. Stoelting & Co., Chicago.	Cat. No. Central Scientific Company, Chicago.	Cat. No., Wm. Gaertner & Co., Chicago.
Battery motor	Two for class	2717 2715	2246 2245	H 3703
Horseshoe magnet	One for 6			H 2503
Hydrometer for light liquids	One for class			H 803
Vibrograph	One for class	1745	3035	H 3901
Tuning-fork for vibrograph	One for class	1699	3037	
Tuning-fork, 256	One for 4	1693	3012	H 4001
Glass tube, 1½ x 40	One for 4	5632	4982	
Rubber stoppers to fit tube, one-hole,	One for 4	5800 No. 9	5213 No. 9	H 501
Sulfuric acid	1 lb	Cat. A	Cat. M	Cat. H
Commutator	One for 6	2979	2601	H 2901
Leclanche cells	One for 4	2389	2115	
Magnet wire D C C		6958	6107	
Magnet wire, 1 lb. No. 24		Specify size.	Specify size.	
Ammonium chlorid	1 lb			
Thousand-ohm coil	One for 4			H 3101
Resistance-box	One for 6	2941	2442	
Unknown resistance-coil German silver wire, D C C No. 28	About 1 lb			
Wheatstone bridge	One for class	2917	2473	H 3201
Galvanometer, D'Arsonval	One for class	2845	2414	H 3001
Small glass tubing, $\frac{5}{16}$	2 lbs	5638	4981	
Plane mirror	One for 2	3429	3201	
Plate-glass rectangle	One for 2	3621	3301	
Double-convex lens, 6-inch focus	One for 2	3399	3281	
Convex lens with mounting and wire screen	One for 2			H 4601
Screen holders	One for 2	3463	3288	
Lens support	One for 2	3460	3285	
Pr. blocks to support meter stick	One for 2	3459	3290	
Condenser clamp	One for 4	5399	4717	
Iron tripod base, 6 lbs.	One for 4	4302	2	S 602
Iron rods to fit, 13 mm. x 40 cm	One for 4	4341	21	S 204
Right-angle piece	One for 4	4357	38	S 1001
Or this set of supports, tripod rod, clamp, burette holder	One for 4			H 1002
Tripod for Bunsen burners 5-in.	One for school	6010 5 or 6	5443 5 or 6	
Ring clamp, 4-in	One for 4	5899	5201	

* Filled.
† Not filled.

REFERENCE BOOKS.

BOOKS OF ABOUT THE SAME GRADE AS THE HIGH-SCHOOL WORK.

A First Course in Physics, Millikan & Gale; Ginn & Co., Chicago.

A Laboratory Course in Physics, Millikan & Gale; Ginn & Co., Chicago.

Laboratory Manual of Physics, Cheston, Dean & Timmerman; American Book Company, New York.

Physical Laboratory Manual, Coleman; American Book Company, Chicago.

Laboratory Manual of Physics, Crew & Tatnall; The Macmillan Company, Chicago and New York.

Manual of Experiments in Physics, J. S. Ames & J. A. Bliss; Harper Bros., New York. This is a somewhat more advanced book, but very good to have in the library.

ADVANCED BOOKS FOR REFERENCE.

A Text Book of Physics, Watson, and—

Elementary Practical Physics (lab.), Watson; Longmans, Green & Co., New York and Chicago.

GENERAL READING AND OF HELP TO THE INSTRUCTOR.

On Laboratory Arts, Richard Threlfall; The Macmillan Company. (Tells how to do things.)

The Art of Projecting, A. E. Dolbear; Lee & Sheperd, Boston.

On Sound, Tyndall; Harper Bros. (Popular lectures; classics.)

Soap Bubbles, C. V. Boys. (Romance of Science series.) (Get from

McClurg & Co., Chicago.) E. & J. J. Young & Co., New York. Popular lectures on soap films, showing many interesting and instructive experiments.

Spinning Tops, Perry. (Romance of Science series.) (Get from McClurg & Co., Chicago.) A most interesting series of lectures on the mechanics of spinning bodies. Popular style.

Pioneers of Science, Oliver Lodge; The Macmillan Company. Very interesting and inspiring. Popular style.

Tables of Constants, Smithsonian Physical Tables, Smithsonian Institution, Washington, D. C.

History of Physics, Cajori; the Macmillan Company.

CHEMISTRY. *One unit.*

The work in chemistry consists of two parts, the study of the text and the laboratory work. The year's work should be about equally divided between these two parts. Both the text-book matter and the laboratory work should be included in the recitation. This period should be enlivened by experiments and illustrations by the teacher, especially performing experiments illustrating laws which are too difficult for the pupils in their laboratory work.

The work outlined can be most satisfactorily accomplished by having two recitations of forty-five minutes each, two laboratory periods of ninety minutes each, and a forty-five minute period for review, examination or lecture per week.

It is better to complete a portion of the work thoroughly rather than cover the whole subject and not master it. Pupils who have done laboratory work in the proper way and can show their original notes, who have thoroughly completed a good text as far as the metals, and who can write reactions and solve problems involving this part of the text will be allowed an entrance unit at the University. This includes about the first sixty experiments and the part of the text which they supplement.

The following outline, based on the state text, is intended to present in clear form the subject-matter for a year's work. It will be found helpful, particularly to the inexperienced teacher. It is intended only as a guide, not in any sense to take the place of the text. The resourceful instructor will modify and adapt it to the conditions under which the course must be given.

TEXTS.

I. Introduction.

1. The metric system.
    - (1) The unit of length, of capacity, of weight; their relations, and the standard of each.
2. Thermometers.
    - (1) Fahrenheit and Centigrade, relation.
3. Relation of chemistry and physics.
    - (1) Physical change.
    - (2) Chemical change.
    - (3) Mechanical mixture.
    - (4) Chemical compound.
    - (5) Things that cause chemical action.
4. The elements.
    - (1) Distinguish from compounds.
    - (2) Relative importance of twenty.
    - (3) Symbols.
    - (4) Reagents and reactions.
5. Importance of the study of chemistry.
    - (1) To make exact thinkers.
    - (2) To assist in the study of other subjects.
    - (3) To develop the power to do things.
    - (4) The commercial side.

I. Introduction—*continued.*

6. The laboratory apparatus for the individual pupil.
    (1) Names of articles.
    (2) Uses.
    (3) Care.

7. The laboratory in general.
    (1) Care of apparatus for class use.
    (2) Cleanliness of tables, floor, sinks, hoods, etc.
    (3) Methods of distributing chemicals.
    (4) How to handle chemicals.

OUTLINE.

In studying the elements and their compounds a general outline like the following will be helpful:

I. Occurrence.
Free in nature; compounds found in nature.

II. Physical properties.
Form; color; diffusibility; density; odor; solubility; weight of one liter; melting-point; boiling-point; conditions under which it may be changed to other forms.

III. Chemical properties.
Active or inactive; other forms found in the laboratory; combustibility; ability to support combustion; action on water.

IV. Methods of making in the laboratory.
The reactions; how collected; how purified.

V. Test by which it is recognized.

VI. Problems.

VII. Commercial uses.

LECTURE WORK.

The apparatus for illustration and lecture work may be made as expensive as any school board wishes to afford; but a teacher may do good work with a small amount, if it is judiciously selected. Get the small and necessary apparatus first and add to it year by year.

The following list is as complete as any high school needs:

APPARATUS FOR LECTURE-TABLE, STOREROOM AND SPECIAL WORK.

ARTICLE.	Kind.	Size.	Number.	Cost.
A large table †				
Apparatus*	Electrolytic, with removable electrodes		1	$10 00
Apparatus	Kipp's	2-quart	2	12 00
Balance*	Chemical		1	100 00
Bath*	Water	6-inch	1	1 75
Beakers	Griffin	1-8	2 nests	4 00
Bottles	Reagent	250 cc	24	4 80
Bottles*	Salt mouth, g. s.	500 cc	48	8 00
Bottles*	Salt mouth, g. s.	1000 cc	48	9 00
Casseroles*	R. B. porcelain	Number 4	2	1 20
Clamps and collars	4-finger	Large	2 of each	2 00
Condensers	Glass	6 cm	2	2 50
Corkscrew	Ordinary	Large	1	15
Crucibles*	Porcelain	Number 0	12	1 20
Cylinders	Gas	Large	6	1 80
Cylinders	Graduated	250 and 500 cc	2	2 50
Desiccator*	Glass	6-inch	1	1 50
Dishes*	Crystallizing	1-10	1 nest	1 50
Dishes*	Evaporating, porcelain	Number 10	2	3 00
Flasks	Distilling	500 cc	4	1 30
Flasks	Erlenmeyer	500 cc	10	1 50
Flasks	German	1000 cc	10	2 00
Flasks*	Graduated	100, 250, 500, 1000 c.c.	4	3 00
Flasks	Round bottom, short neck	2000 cc	4	1 20
Funnels	Glass	8-inch and 6-inch	2	75

ARTICLE.	Kind.	Size.	Number.	Cost.
Funnels*	Separatory	150 cc.	2	1 50
Gas-holder*	Zinc	5-gallon	1	11 00
Hydrometers*	Alcohol, light and heavy liquids		3	3 00
Mortar and pestle	Wedgewood	6-inch	2	2 00
Oven*	Drying	8x12 inches	1	10 00
Pinch-cocks	Hoffman's	Medium	2	80
Pneumatic troughs	Glass	6x8x12	2	5 00
Retort	Copper	1 pint	1	1 50
Rule	Metric	1 meter long	1	50
Stands	Burette	2 clamps	2	3 00
Stands	Ring	Large	2	1 50
Stands	Filter	For four funnels	2	2 00
Tongs*	Crucible		1 pair	50
Triangles*	Porcelain	Medium	6	60
Tube*	Hoffman's	100 cc.	1	3 00
Tubes	Test	8-inch	50	1 50
Tubes	Test on foot	8-inch	12	1 50
Tubes	U	6-inch	12	1 50
Wash-bottle	Wicker neck	1 liter	2	1 25
Watch-glasses*	Thin	12 cm.	12	1 00
Water	Apparatus for distilling	½ gallon per hour	1	30 00
Weights*	Analytical	1 mg.—50 gms.	1 set	10 00

*In small schools where the means are limited apparatus marked with an asterisk may be omitted.

†Should be in front part of classroom, with gas connections, sink and water.

LIST OF LABORATORY EXPERIMENTS TO BE PERFORMED BY EACH PUPIL.

This outline is not intended to be a laboratory manual for the pupil; it is only suggestive, and for the teacher only.

In arranging these experiments three ideas have been constantly in mind; the intellectual development and training of the pupil; the practical utility of chemistry; and the preparation of the pupil to continue the work in this subject at higher institutions of learning.

I. To show a physical and a chemical change.
   1. Heat a platinum wire.
   2. Heat a piece of magnesium wire.

II. To illustrate some causes of chemical change.
   1. Heat.
   2. Light.
   3. Friction.
   4. Solution.
   5. Electricity.

III. To show the difference between a mechanical mixture and a chemical compound.
   1. Iron filings and sulfur.
   2. Separate by carbon bisulfid.
   3. Separate by hydrochloric acid.
   4. Unite them chemically.

IV. To make hydrogen by the action of a metal on water.
   1. Sodium.
   2. Potassium.
   3. Magnesium (hot water).

V. To make hydrogen by the action of an acid on a metal and show its properties.
   1. To show its lightness.
   2. Diffusibility.
   3. Burn it.
   4. Product of combustion.
   5. The salt formed by the action of the acid on the metal.

VI. To illustrate the law of constant proportions.
   1. A fixed weight of magnesium on acid.
   2. Problems.

VII. Methods of making oxygen.
1. From mercuric oxid.
2. From potassium chlorate.
3. From manganese dioxid.

VIII. To make oxygen and to study its properties.
1. Burn sulfur, phosphorus, carbon, sodium, and iron in it.
2. Study the products of their combustion.

IX. Make a synthesis of water.
1. By hydrogen over hot copper oxid.

X. Water contained in vegetable and animal substances.
1. Wood, meat, potato, etc.

XI. Water of crystallization.
1. Zinc sulfate, gypsum, copper sulfate.

XII. Precipitate calcium carbonate from water by boiling.
1. Impurities in natural waters.

XIII. Purify water by—
1. Filtration.
2. Settling.
3. Distillation.
4. Boiling.

XIV. Efflorescence.
1. Sodium carbonate.
2. Zinc sulfate.
3. Sodium sulfate.

XV. Deliquescence.
1. Calcium chlorid.
2. Sodium hydroxid.

XVI. Water as a solvent of—
1. Sodium chlorid.
2. Alum.
3. Manganese dioxid.
4. Barium sulfate.
5. Glycerin.
6. Chloroform.
7. Ammonia.

XVII. Prepare and study the properties of chlorin.
1. Solubility.
2. Action on antimony.
3. On phosphorus.
4. On copper.
5. On turpentine.
6. Uses as a bleaching agent.

XVIII. Chlorin made from bleaching-powder.
1. Used as ink eradicator.

XIX. Make potassium chlorate and potassium chlorid.
1. Separate them.
2. Test each product.

XX. Make and study the properties of hydrochloric acid.
1. Solubility.
2. Combustibility.
3. Action on litmus paper.
4. Action of the gas on ammonia.
5. Test a solution of the gas.
6. Add some to zinc.
7. Add some to manganese dioxid.
8. Taste a very dilute solution.
9. Crystallize the salt formed.

XXI. Neutralize a solution of—
   1. Hydrochloric acid.
   2. Sulfuric acid.
   3. Nitric acid, with solution of—
      1. Sodium hydroxid.
      2. Calcium hydroxid.
      3. Ammonium hydroxid.
      4. Barium hydroxid.
   4. Crystallize the salts formed.

XXII. Make and study the properties of nitrogen.
   1. Sodium nitrite and ammonium chlorid heated.

XXIII. Make nitrogen from the air.
   1. By phosphorus.

XXIV. Determine the amount of oygen in the air.
   1. By volume.
   2. By weight.

XXV. Show the presence of moisture in the air.
   1. Calcium chlorid.
   2. Sodium hydroxid.

XXVI. Test the air for carbon dioxid.
   1. With lime-water or baryta-water.

XXVII. Make ammonia and study its properties.
   1. With glue and calcium hydroxid.
   2. Ammonium chlorid and sodium hydroxid solution.
   3. Ammonium nitrate and potassium hydroxid.
   4. Ammonium chlorid and lime.
   5. Test its solubility.
   6. Temperature change on solution.
   7. Density compared with air.
   8. Combustibility.
   9. Action on hydrochloric acid gas, etc.

XXVIII. Preparation and properties of nitric acid.
   1. Use of sodium nitrate and sulfuric acid.
   2. Action of the acid on metals, magnesium, copper, tin, etc.

XXIX. Preparation and properties of a nitrite.
   1. Sodium nitrate and lead.
   2. Nitrous acid.
   3. A reducing agent.
   4. Distinguish a nitrate from a nitrite.

XXX. Nitrogen tetroxid and nitrogen dioxid.
   1. Heat lead nitrate.
   2. Combustibility.
   3. Change the one to the other.

XXXI. Nitric oxid and its properties.
   1. Copper and dilute nitric acid.
   2. Action on air.
   3. Solubility and combustibility.
   4. Burn red phosphorus in it.
   5. Crystallize the copper nitrate.

XXXII. Nitrous oxid and its properties.
   1. Heat ammonium nitrate.
   2. Water and nitrous oxid is formed.
   3. Solubility, odor, etc.
   4. Supports combustion.

XXXIII. Allotropic forms of sulfur.
   1. Properties of roll sulfur.
   2. Forms.
      (1) Rhombic. (2) Plastic. (3) Monoclinic.

XXXIV. Preparation and properties of hydrogen sulfid.
1. Combustibility and ability to support combustion.
2. Action on litmus, silver, etc.
3. Action on salts of metals in acid solution.
(1) Copper, (2) lead, (3) arsenic, (4) antimony, (5) mercury, (6) cadmium.
4. Action on salts of metals in alkaline solution.
(1) Sodium, (2) calcium, (3) zinc, (4) iron(ous), (5) iron(ic), (6) manganese.

XXXV. Sulfur dioxid and its properties.
1. Burn sulfur.
2. Anhydrid of sulfurous acid.
3. Bleaching agent.
4. Also made by the action of sulfuric acid on copper.

XXXVI. To make sulfates.
1. Any soluble sulfate, barium chlorid, etc.
2. Test for sulfate.

XXXVII. Properties and forms of carbon.
1. Diamond.
2. Graphite.
3. Amorphous.
(1) Charcoal, (2) lampblack, etc.

XXXVIII. Carbon as an absorbent.
1. Litmus solution and animal charcoal, etc.
2. Cold charcoal and gases.

XXXIX. Carbon a reducing agent.
1. Copper oxid and carbon.
2. Arsenic trioxid and animal charcoal.

XL. The action of acids on carbonates.
1. A salt and carbon dioxid formed.

XLI. Carbon dioxid in the breath.
1. Lime-water.

XLII. Preparation and properties of carbon dioxid.
1. Effect on water.
2. Combustibility.
3. Density.
4. Pass through lime-water.
5. Make the acid carbonate.

XLIII. Preparation of the carbonate.
1. From sodium hydrate.

XLIV. Carbon monoxid.
1. From oxalic acid.
2. Properties.

XLV. Preparation and properties of methane.
1. Sodium acetate and soda lime.
2. Physical properties.
3. Chemical properties.
4. Natural gas.

XLVI. To determine molecular masses.
1. Alcohol.
(1) By freezing-point.
(2) By boiling-point.
2. Gases.
(1) By comparison of weights.

XLVII. The structure of a flame.
1. Bunsen's flame.
2. Candle flame.
3. Hydrogen flame.

XLVIII. Prepare and study the properties of bromin.
1. Potassium bromid, manganese dioxid and sulfuric acid.
2. Density of the liquid.
3. Solubility.
4. Test for bromin.
5. Replaced by chlorin.
6. Action on sodium hydroxid.

XLIX. Iodin and hydriodic acid.
1. Potassium iodid, manganese dioxid and sulfuric acid.
2. Test for free iodin.
3. Replaced by bromin and chlorin.
4. Sublime it.
5. Solubility in water, in alcohol.
6. Iodin solution and hydrogen sulfid.

L. Hydrofluoric acid.
1. Etch glass.

LI. The silver halides.
1. Silver nitrate and sodium chlorid.
2. Potassium bromid.
3. Potassium iodid.
4. Solubility of each precipitate in ammonium hydrate.

LII. Hydrogen peroxid.
1. Sodium peroxid and water made acid by sulfuric acid.
2. Oxidizing agent.
3. Reducing agent.
4. Test for.
5. Action on a solution of potassium permanganate.

LIII. Phosphorus and phosporic acid.
1. Solubility of red and of yellow phosphorus in carbon bisulfid.
2. Change the red to yellow by heating in a closed tube.
3. Add silver nitrate, calcium chlorid, magnesium sulfate and ammonia water to a solution of phosphoric acid.

LIV. Arsenic and its compounds.
1. Reduce arsenic trioxid.
2. Dissolve in hydrochloric acid and add hydrogen sulfid.
3. Add sodium hydrate to arsenic trioxid.
4. Oxidize some arsenic.

LV. Antimony and its compounds.
1. Action of acid on the metal.
2. Pass hydrogen sulfid into the solution made by *aqua regia.*
3. Dissolve some tartar emetic and pass hydrogen sulfid into the solution.
4. Reduce some antimony trioxid.
5. Oxidize some antimony.

LVI. Bismuth and its compounds.
1. Properties of the metal.
2. Dissolve some bismuth nitrate; add hydrochloric acid to prevent hydrolysis.
3. Add much water to some of this solution.
4. Add hydrogen sulfid to the remainder.

LVII. Borax and boric acid.
1. Make borax beads on the end of a platinum wire.
2. Test for the following with beads: Chromium, manganese, cobalt, nickel.
3. Make boric acid by adding hydrochloric acid to a hot solution of borax.
4. Change it back to borax with sodium carbonate.

LVIII. Evidence of ionization.
1. Solution of silver nitrate on a solution of potassium chlorate.
2. Solution of silver nitrate and potassium chlorid.
3. Ammonium hydrate on ferric chlorid.
4. Ammonium hydrate on a solution of potassium ferrocyanid.
5. Add water to a dry mixture of soda and cream of tartar.

LIX. Sodium and its compounds.
1. Properties of sodium.
2. Heat sodium bicarbonate.
3. Crystals of sodium salts.
4. Add a solution of sodium carbonate to solutions of calcium chlorid.
5. Test for sodium.
6. Write formulas and names of thirty sodium salts.
7. Sodium salts react alkaline in solution.
8. Solubility of sodium salts.

LX. Potassium and its compounds.
1. Study the physical and the chemical properties of potassium.
2. Make potassium nitrate from sodium nitrate.
3. Make gunpowder, explode, and study the residue.
4. Heat cream of tartar and study the residue.
5. Test for potassium.
6. Write and name twenty-five potassium salts.
7. Solubility of potassium salts, exceptions.

LXI. Distinction between the salts of the alkali metals.
1. Sodium amalgam and ammonium chlorid.
2. Potassium salts and tartaric acid.
3. Ammonium salts and alkali.
4. Sodium cobalt nitrite and potassium and ammonium salts.

LXII. Calcium salts.
1. Burn a piece of marble.
2. Add acid to old mortar.
3. Gypsum and water of crystallization.
4. Plaster of Paris and water.
5. Soluble calcium salt in solution, add solutions of ammonium carbonate, oxalate, etc.

LXIII. Strontium and barium salts.
1. Treat a solution of strontium chlorid with a solution of ammonium chlorid.
2. Treat a like solution of sulfuric acid.
3. Try the flame test.
4. Name some soluble strontium salts; some that are insoluble.
5. Treat the corresponding barium salts in the same way.

LXIV. Magnesium and its salts.
1. Study its properties, both physical and chemical.
2. To a soluble magnesium salt add a solution of sodium carbonate.
3. To the same add ammonium hydroxid and disodium hydrogen phosphate.
4. Action of acid on magnesia.

LXV. Zinc and its compounds.
1. Physical and chemical properties of zinc.
2. Heat a piece on charcoal.
3. Action of acids on zinc.
4. Action of strong sodium hydrate on zinc.
5. Sodium hydrate on a solution of a zinc salt.
6. Zinc solution of hydrogen sulfid.
7. Solubility of the different zinc salts.

LXVI. Cadmium salts.
1. Color of the sulfid.
2. Solubility of the sulfid, etc.

LXVII. Mercury and its salts.
1. Physical and chemical properties.
2. Action on dilute nitric acid.
3. Action on concentrated nitric acid.
4. Distinguish between the "ic" and "ous" salts.
5. Mercury precipitated by other metals.
6. A soluble salt and hydrogen sulfid.

LXVIII. Copper and its compounds.
1. Properties of the metal.
2. Action of hydrochloric, nitric and sulfuric acid on copper.
3. Solution of copper sulfate on hydrogen sulfid.
4. Fehling's solution and grape-sugar.
5. Replaced by other metals.

LXIX. Silver and its salts.
1. Properties of the metal.
2. Action of nitric acid on the metal.
3. Sunlight on the halogen salts.
4. Solution and hydrogen sulfid.
5. Solution and a cyanide solution.

LXX. Aluminum and its compounds.
1. Study the properties of the metal.
2. Action of acids on the metal.
3. The action of sodium hydroxid.
4. Ammonium hydrate on a solution of a salt.
5. Make alum.
6. Action of sodium carbonate on the aluminum hydrate.
7. Use of its salts as a mordant.

LXXI. Iron and its salts.
1. Properties of the metal.
2. Make ferrous chlorid.
3. Tests for the ferrous salts.
4. Make ferric chlorid and tests for ferric salts.
5. Ferrous sulfate and hydrogen sulfid, alkaline solution.
6. The same, acid solution.
7. Reduction of the "ic" to the "ous" by hydrogen sulfid.

LXXII. Nickel and cobalt and their salts.
1. Properties of the metals.
2. Make borax beads with their salts.
3. Hydrogen sulfid in both acid and alkaline solution.
4. Color of the different salts and their solutions.

LXXIII. Manganese compounds.
1. To make the sulfid.
2. The hydroxid.
3. The permanganate.
4. Reduction by grape-sugar.
5. Manganese dioxid.

LXXIV. Chromium compounds.
1. Color of the salts, etc.
2. Make the chromate from the dichromate.
3. Make the dichromate from the chromate.
4. Chromate solution and barium chlorid.
5. Chromic chlorid and sodium hydroxid.
6. Distinguish a chromic salt from a chromate.
7. Change one to the other, and reverse.

LXXV. Lead and its salts.
1. Properties of lead.
2. Reduce the oxid.
3. From a solution of a lead salt precipitate the lead salts by hydrochloric acid, potassium chromate, sulfuric acid, sodium hydroxid, etc.
4. Replace lead in its salts by zinc.

LXXVI. Tin and its compounds.
1. Properties of the metal.
2. Action of hydrochloric acid on the metal.
3. Mercurous chlorid and stannous chlorid.
4. Precipitate the "ic" and "ous" sulfids.
5. Make "ic" and "ous" hydroxid.
6. Tin replaced in its salts by zinc.
7. Make the oxid.

LXXVII. To determine the amount of oxygen obtainable from a weighed amount of mercuric oxid.
1. Hard glass tubing and eudiometer.
2. Apply the gas laws.

LXXVIII. To determine the amount of crystal water in salts.
1. Copper sulfate.
2. Potassium alum.

LXXIX. The law of definite proportions.
1. Standard solution of hydrochloric acid and potassium hydroxid.

LXXX. The law of multiple proportions.
1. Potassium chlorate and potassium perchlorate.

APPARATUS.

Each pupil should have and be responsible for the following list of apparatus, or as much of it as it is possible to furnish him:

ARTICLE.	Kind.	Size.	Number or amount.	Cost.
Bath	Sand	10x2 cm	1	15 cts.
Beakers	Plain	1–6	6	50
Blowpipe	Brass	20 cm. long	1	10
Bottles	Reagent	120 cc. with g. s.	5	75
Burner	Bunsen	Ordinary	1	20
Candle holder	Wire handle	20 cm. long	1	15
Collar and clamp	Two-finger	Small	1	50
Corks	Cork	Assorted	20	05
Covers	Ground glass	10x10 cm	2	10
Cylinders	Gas	6x20 cm	2	60
Cylinder	Graduated	50 cc.	1	30
Dish	Glass, crystallizing	10x20 cm	1	30
Dish	Evaporating, R. B	No. 4	1	30
Files	1 round and 1 triangular	10 cm	2	10
Flasks	German	500, 250, 100 cc.	3	37
Flask	Oxygen	150 cc.	1	15
Flasks	Woulff's 2-neck	300 cc.	2	30
Forceps	Steel	10 cm	1 pair	10
Funnels	Glass	8 cm. and 4 cm	2	18
Gauze	Asbestos	10x10 cm	1	05
Magnet	Horseshoe	Small	1	05
Matches	Safety		2 boxes	02
Mortar and pestle	Porcelain	No. 4	1	30

ARTICLE.	Kind.	Size.	Number or amount.	Cost.
Paper	Drying	Large	4 sheets	04 cts.
Paper	Cut filter	10 cm.	50	07
Paper	Litmus	Large	1 sheet	05
Pneumatic trough	Tin	20x30x10 cm.	1	25
Retort	Hard glass	250 cc.	1	30
Ring stand	Iron	Large	1	50
Rings	Iron	1 large, 1 small	2	30
Spatula	Horn	10 cm.	1	10
Spoon	Deflagrating		1	15
Stoppers	1 one-holed and 1 two-holed rubber	No. 5 and No. 6	2	15
Test-tube holder	Wire	10 cm. long	1	10
Test-tube rack	Wooden	Small	1	15
Towel	Linen	1 yard	1	10
Tripod	Iron	Medium size	1	30
Tube	Calcium chlorid	10 cm.	1	10
Tubes	Specimen	10x2 cm	12	24
Tubes	Test	12x1.5 cm	12	24
Tube	Thistle	20 cm. long	1	10
Tubing	Hard glass	6 mm.	30 gms.	05
Tubing	Hard glass	15 mm	20 gms.	03
Tubing	Soft glass	6 mm.	200 gms.	15
Tubing	Maroon rubber	4 mm.	100 cm	15
Tubing	For Bunsen burner	6 mm.	60 cm	20
Watch-glass	Light	5 cm. in diameter	2	10
Wire	Copper	Small	100 cm	01
Wire	Platinum	Small	5 cm	10

If all the experiments are to be performed, the following list of class apparatus is necessary:

I.—For the use of the class.

ARTICLE.	Kind.	Size.	Number.	Cost.
Balance	In a case	8-inch beam	1	$10 00
Barometer	Metric		1	10 00
Bellows	Foot	Medium	1	6 00
Blast lamp	Bunsen's		1	3 50
Bottles	Glass-stoppered	500 cc.	24	4 00
Cork-borers	Hard brass	1-5	1 set.	60
Cork-press	Rotary	Ordinary	1	60
Hood	With good draft	6 feet wide	1	(?)
Jars	Crockery	2 gallons	2	40
Jars	Crockery	1 quart	12	60
Mortar and pestle	Iron	1 quart	1	75
Table *				125 00
Thermometer	Centigrade, for room	12-inch	1	1 00

* Should have eight gas connections, four water taps, two sinks, sixteen drawers, and eight cases below.

The above in clean, dry, well lighted, heated and ventilated room.

II.—To be checked out to the pupils and returned as soon as the experiment is performed.

ARTICLE.	Kind.	Size.	Number.	Cost.
Burettes	Mohr's	50 cc.	4	$5 00
Dishes	Lead	4 x 2 x ½ inches	4	40
Eudiometers	Without platinum wire	100 cc.	4	6 00
Gauze	Wire	4 x 4 inches	4	40
Magnifying glass	Single lens	¾ in. in diameter	1	1 50
Pinch-cocks	Mohr's	Medium	4	48
Weights	Metric	1 mg. to 50 gms.	1 set.	2 50

Chemicals should be bought in quantity from a regular wholesale house. The cost per pupil for the course should not exceed seventy-five cents.

CHEMICALS NECESSARY TO PERFORM ALL THE EXPERIMENTS GIVEN IN THE OUTLINE.

1. Ag foil.
2. $AgNO_3$
3. Al wire and filings.
4. $Al_2(SO_4)_3$
5. As
6. $AsCl_3$
7. As_2O_3
8. $BaCl_2$
9. $Ba(NO_3)_2$
10. $Ba(OH)_2$
11. $BaSO_4$
12. Bi
13. $BiCl_3$
14. $Bi(NO_3)_3$
15. Br
16. C charcoal, animal charcoal.
17. $CHCl_3$
18. $C_{10}H_{16}$
19. CS_2
20. $C_6H_{12}O_6$
21. $C_{12}H_{22}O_{11}$
22. $(C_6H_{10}O_5)x$
23. CH_3OH
24. C_2H_5OH
25. $(C_2H_5)_2O$
26. $C_3H_5(OH)_3$
27. $CaCl_2$ fused and crystals.
28. $CaOCl_2$
29. $CaCO_3$
30. $CaFl_2$
31. CaO
32. $CaSO_4 \cdot 2H_2O$
33. $(CaSO_4)_2 \cdot H_2O$
34. $CdSO_4$
35. $Co(NO_3)_2$
36. $CrCl_3$
37. Cu foil wire filings.
38. CuCl
39. $CuCl_2$
40. $Cu(NO_3)_2$
41. CuO wire form and powdered.
42. $CuSO_4$
43. Fe wire and filings.
44. $FeCl_3$
45. FeS
46. $FeSO_4$
47. HCl
48. $H_2C_4H_4O_6$
49. $H_2C_2O_4$
50. $HC_3H_3O_2$
51. HNO_3
52. H_2O
53. H_2O_2
54. H_3PO_4
55. H_2SO_4
56. H_2SO_3
57. Hg
58. $HgCl_2$
59. $HgNO_3$
60. $Hg(NO_3)_2$
61. HgO
62. I
63. K
64. $KAl(SO_4)_2$
65. KBr
66. KCN
67. KCl
68. $KClO_3$
69. $KClO_4$
70. $K_2Cr_2O_7$
71. K_2CrO_4
72. $K_4Fe(CN)_6$
73. $K_2Fe(CN)_6$
74. $KHC_4H_4O_6$
75. KI
76. $KMnO_4$
77. KNO_3
78. KNO_2
79. KOH
80. K_2SO_4
81. KSCN
82. $KSb(C_4H_4O_6)_2$
83. Mg wire.
84. $MgCl_2$
85. $MgCO_3$
86. $MgSO_4$
87. MnO_2
88. $MnSO_4$
89. Na
90. $Na_2B_4O_7$
91. NaCl
92. $NaC_2H_3O_2$
93. Na_2CO_3
94. $NaHCO_3$
95. Na_2HPO_4
96. $NaNO_2$
97. $NaNO_3$
98. Na_2O_2
99. NaOH
100. Na_2SO_3
101. Na_2SO_4
102. $Na_2S_2O_3$
103. NH_4Cl
104. $(NH)_2CO_3$
105. NH_4NO_3
106. NH_4OH
107. $(NH_4)_2S$
108. $(NH_4)_2SO_4$
109. $Ni(NO_3)_2$
110. P red and yellow.
111. Pb
112. $Pb(C_2H_3O_2)_2$
113. $Pb(NO_3)_2$
114. PbO
115. S
116. Sb
117. $SbCl_3$
118. Sb_2O_3
119. Sn
120. $SnCl_2$
121. $SnCl_4$
122. $Sn(NO_3)_2$
123. $SrCl_2$
124. $Sr(NO_3)_2$
125. Zn dust and granulated.
126. $ZnSO_4$
127. Litmus
128. Methyl-orange.
129. Cochineal.
130. Indigo.
131. Colored calico.
132. Phenolphthalein.
133. Candles.
134. Splinters.
135. Paraffin.
136. Soda-lime.
137. Sodium amalgam.
138. Square glass 4 x 4 in.
139. Meat.
140. Vegetables.

The chemicals for this work need not be chemically pure, but they should be of a good grade. It is always advisable to keep a small stock of c. p. material in the laboratory for special work.

TEXTS. Essentials of Chemistry, Hesler and Smith; An Elementary Study of Chemistry, McPherson and Henderson; First Steps in Chemistry, Ostwald; Introduction to Chemistry, Remsen.

Group IV.

AN OUTLINE FOR A YEAR'S WORK IN PHYSIOGRAPHY.

We have not recommended the continuation of the teaching of a unit of physical geography as an integral part of the course; yet it may be that conditions in some schools make its continuation desirable. Where such is the case, the following outline will be of service.

THE EARTH.

REFERENCES.

1. Davis, Physical Geography, pp. 8-17 (edition of 1899).
2. Gilbert and Brigham, Physical Geography, pp. 1-27.
3. Chamberlin and Salisbury, Geologic Processes, vol. I, pp. 2-5.

A. The earth as part of the universe.
   1. The universe is made up of millions of systems, of which our solar system is one.
   2. The earth is one of the planets of our solar system, which comprises the sun and the planets.

B. The relation of the earth to the sun.
   1. Distance from sun, 92.9 million miles.
   2. Revolves around the sun once in $365\frac{1}{4}$ days.
   3. The mass of the earth is only $\frac{1}{315511}$ of the mass of the sun.
   4. The earth depends upon the sun for its heat and light.

C. The relation of the earth to the other planets.
   1. The planets of our solar system are: Neptune, Uranus, Saturn, Jupiter, Mars, Earth, Venus, Mercury.
   2. Which of the planets are nearer the sun than the earth is?
   3. Some of the planets revolve more rapidly around the sun, some more slowly, than the earth does.
   4. Some of the planets rotate more rapidly, some less rapidly, than the earth does.
   5. Neptune, Uranus, Saturn and Jupiter are larger than the earth; the other planets are smaller.

D. The shape of the earth.
   1. Early conception that the earth was flat.
   2. A globe or spheroid.

E. The size of the earth.
   1. How determined?
      a. By measuring the curvature of the earth. (See Davis's Physical Geography, appendix B, p. 386.)
      b. By traveling around the earth and making measurements. (The diameter of the earth is about 8000 miles; the distance to either pole from the center is about thirteen miles less than from the center to the equator.)

F. The motions of the earth.
   1. Revolution around the sun. Earth goes around sun once in $365\frac{1}{4}$ days, *i. e.*, once a year.

G. Latitudes and longitudes.

THE ATMOSPHERE.

REFERENCES.

1. Davis, Physical Geography, pp. 18-56.
2. Gilbert and Brigham, Physical Geography, pp. 223-273.
3. Chamberlin and Salisbury, Geologic Processes, vol. I, pp. 5-7.

A. Is the atmosphere part of the earth, or an envelope? (Mass of the air is $\frac{1}{1200000}$ of that of the earth.)

B. Height of the atmosphere, how determined?
   1. By means of falling meteorites. They give height of at least 100 miles.
   2. *Aurora borealis.* Height 600 miles.
   3. The determination of the sphere of gravitative control of the earth gives 620,000 miles as the outside limit of the atmosphere.

C. Constituents of the atmosphere.
   1. Nitrogen—it is a dilutent; it has mechanical effects in connection with the wind; it influences pressure; diathermous to heat.
   2. Oxygen—supports animal life and combustion; diathermous to heat.
   3. Carbon dioxid (about 4 parts in 10,000).
      a. Sources of—animal life, and combustion, expiration, and vulcanism.
      b. Uses.
         1. Plant life.
         2. Weathering.
         3. Absorbent of heat.
      c. Is there more carbon dioxid in the air in winter than in summer?
   4. Dust.
      a. Effects of.
         1. Causes condensation of vapor.
         2. Diffusion of light.
         3. Colors of the sky. The bright sunset after the volcanic explosions of Krakatoa in 1883 were due to dust in the air.
      b. What keeps the dust in the air?

D. Is air a mixture, or a chemical compound?

E. The heat of the atmosphere.
   1. What is heat? The movement of the molecules; temperature is the measurement of impact.
   2. How is heat transmitted?
   3. The thermometer.
      a. Principle of.
      b. Why take 32° below freezing as zero? (This was the lowest temperature obtainable from a mixture of snow and ice.)
   4. Isothermal lines.
   5. What are the factors influencing temperature?
   6. Why are high altitudes colder than low altitudes?
   7. What influence annual range of temperature?
   8. What influence the daily range of temperature?

F. The pressure of the atmosphere.
   1. How is its existence proved?
   2. Amount of pressure—how measured?
   3. Principle of the barometer. How high must we go above the sea-level to have mercury drop one inch?
   4. Is pressure constant at any point? What affects pressure?
   5. Importance of differences of pressure.
      a. Cause winds. (What are isobars? What kind of pressure at the equator?)

G. The moisture of the atmosphere.
  1. Evaporation takes place from all moist surfaces; molecules from the surface of the water fly off from collision.
    a. Upon what does the rate of evaporation depend?
    b. When will evaporation from a surface cease?
  2. Relative humidity—depends on temperature.
  3. Absolute humidity—the absolute amount of water vapor in the air.
  4. Condensation.
    a. Conditions for condensation.
      1. Sufficient humidity for saturation.
      2. Dust particles.
    b. Forms which the condensed water vapor takes.
      1. Dew.
      2. Frost.
      3. Fog.
      4. Clouds.
      5. Rain.
      6. Snow.

H. General circulation of the atmosphere.
  1. What is wind? Air in motion along the surface.
  2. Immediate cause of winds?
  3. Ultimate cause of wind?
  4. Strength of wind?
  5. Classes of winds.
  6. Interference with the general circulation of winds.
    a. Secondary circulation.
    b. Unequal heating of land and sea.
    c. Inequalities of land surface.
  7. Results of interference with the general circulation.
    a. Cyclones.
    b. Anticyclones.
    c. Hurricanes.
      1. Compare with cyclones.
      2. Kind of movement.
      3. Occurrence of.
      4. Time of occurrence.
      5. Direction.
    d. Tornadoes.
      1. What? A cyclone of small diameter, high gradient, and circular motion.
      2. When? In the late afternoon in the late spring and summer.
      3. Size? About twenty-five miles by one-fourth mile.
      4. Movement.
      5. Destruction.
      6. Causes of tornadoes.
    e. Cloudbursts.
      1. What? Local. Very rapid condensation, of short duration.
      2. Cause.
      3. Where?
    f. Periodic winds.
      1. Monsoons.
      2. Land and sea breezes.
      3. Mountain valley breezes.
    g. Miscellaneous winds.
      1. Hot winds associated with cyclones.
      2. Cold winds associated with anticyclones.
      3. Chinook winds.
    h. Effects of winds.
      1. Distribution of temperature.
      2. Distribution of moisture.

H. General circulation of the atmosphere—*continued.*
  8. Climate.
    a. What? The average meteorological conditions of an area for a long time.
    b. Elements?
      1. Temperature.
      2. Wind.
      3. Moisture.
    c. Factors affecting climate.
      1. Nearness to sea.
      2. Latitude.
      3. Altitude.
      4. Winds.
      5. Topographic relations.
    d. Climate zones—bases for?
      1. Mathematical—latitude.
      2. Isotherms.
      3. Moisture.
      4. Winds.
    e. Divisions of climate in the north temperate zone.
      1. Moist and dry.
      2. Equable and variable.
      3. Interior and coastal.
      4. Low and high altitudes.
    f. Weather.
      1. What?
      2. Maps.
      3. Value of weather maps.

OCEANS.

REFERENCES.

1. Gilbert and Brigham, Physical Geography, pp. 279-301.
2. Davis, Physical Geography, pp. 57-90.
3. Chamberlin and Salisbury, Geologic Processes, pp. 309-374.
4. Thompson, Voyage of the "Challenger," 2 vols.
5. Thompson, Depth of the Sea.
6. Barker, Deep Sea Soundings.
7. Wyld, Thalassa.
8. Shaler, Sea and Land.

A. Distribution.

B. Depth.

C. Topography of the bed.
  1. Very flat; on the land, degradation is more important than aggradation; in the ocean, aggradation is more important than degradation.
  2. Some irregularities.

D. Life.

E. Composition. Every 100 parts of sea-water contain about 3.44 parts by weight of mineral matter in solution. The principal acids, solids and bases are shown in the following table (see C. and S., p. 309):

Chlorid of sodium	77.758
Chlorid of magnesium	10.878
Sulfate of magnesium	4.737
Sulfate of lime	3.600
Sulfate of potash	2.465
Bromid of magnesium	.217
Carbonate of calcium	.345
	100

F. Movements.
  1. Causes of—
    a. Unequal densities.
    b. Winds.

F. Movements—*continued.*
  1. Causes of—
    c. Attraction of sun and moon.
    d. Earthquakes, volcanoes, landslides.
    e. Differences of level of the surface.
  2. Classes of movement.
    a. Waves.
    b. Currents.
    c. Tides.
      1. Cause of.
      2. Variation in the height of tides at the same place.
    d. Drift.
    e. Creep. May be vertical or horizontal.

G. Temperature.
  1. Horizontal variation in the Red sea from 90° to 28° F.
    a. Cause of—
      1. Latitude.
      2. Currents.
      3. Winds.
      4. Distribution of land.
      5. Storms.
  2. Vertical variation.

H. Deposits at the bottom.
  1. Deep sea—mud, ooze, etc.
  2. Shallow water—muds, sands, gravel, etc.

OUTLINE OF WORK ON LAND.

A. Agents modifying land.
  1. Gradational agents.
    a. Agents of weathering.
    b. Ground-water.
    c. Streams.
    d. Wind.
    e. Shore-lines.
    f. Glaciers.
    g. Lakes.
  2. Vulcanism and diastropism.
    a. Volcanoes.
    b. Earthquakes.
    c. Changes of level.

B. The great topographic forms.
  1. Plains and plateaus.
  2. Mountains.

WEATHERING.

REFERENCES.

1. Davis, pp. 99-103; 263-275.
2. Mill, §§ 310-313.
3. Chamberlin and Salisbury, vol. I, ch. 2; also 105-109.

A. General notion of.

B. Agents of disintegration in weathering; discussion of this work.
  1. Solution.
  2. Changes of temperature.
    a. Not involving freezing-point. How disruption is affected; where the process is important.
    b. Involving freezing-point.
  3. Plants and animals.
    a. Root splitting.
      1. Lichens.
      2. Ants.
      3. Earthworms.

B. Agents of disintegration—*continued.*
  4. Beating of rain.
  5. Gravity.
  6. Wind (discuss briefly here).

C. Rate of weathering.
  1. Character of rock undergoing change.
  2. Climate.
  3. Rate of removal of waste.

D. Relation of weathering to erosion. Weathering is preparation for transportation.

E. Results of weathering.
  1. Formation of rock mantle.
    a. Discuss transition from soil to subsoil; to rock.
    b. Thickness of soil dependent on—
      1. Rate of formation.
      2. Rate of removal.
    c. Some examples of thickness: 300 feet in Brazil; 50 feet to 100 feet in some of Southern states.
    d. Does absence of soil mean that none is being formed? Kind of soil at any given place? Soils and man.

F. Topographic results.
  1. Talus piles.
  2. Serrate topography of high altitudes.
  3. Columns, boulders of disintegration, etc., due to differential weathering.

GROUND-WATER.

REFERENCES.

1. Davis, pp. 224-230.
2. Mill, §§ 313-317.
3. Chamberlin and Salisbury, vol. I, ch. 4.

A. Facts about.
  1. Facts of existence of ground-water. How shown?
  2. Source of.
  3. What determines amount of rain-water which enters ground?
    a. Porosity of soil.
    b. Slope.
    c. Climate.
    d. Rate of precipitation.
  4. The level of ground-water.
  5. Is level of ground-water constant? How known?
  6. Form of water surface.
  7. Depth to which ground-water goes. How limited is descent?
  8. Amount of ground-water.

B. Work of ground-water.
  1. Mechanical.
  2. Chemical.
    a. Solution. Can all waters dissolve? Solvent power varies with—
      1. Heat.
      2. Pressure.
      3. Content.
    b. Deposition. Due to—
      1. Change of temperature.
      2. Evaporation.
      3. Change of pressure.
      4. Mingling of solutions.
      5. Plants.
    c. Types of change brought about.
      1. Subtraction; rock disintegration.
      2. Substitution; petrifaction.
      3. Addition; rock cementation; veins.
      4. New combinations.

C. Results of work of ground-water.
   1. In weathering—already discussed.
   2. Caves and cave deposits.
   3. Sinks.
   4. Natural bridges.
   5. Creep, slump, and landslides.

D. Springs.
   1. Notion of.
   2. Types of—
      a. Hillside spring.
      b. Fissure spring.
      c. Artesian wells.
      d. Geysers.
         1. What?
         2. Where?
         3. Phenomena of eruption.
         4. Cause of eruption and steam.
         5. Fate of geysers.
         6. Deposits about geysers.

STREAM WORK.

See Chamberlin and Salisbury, vol. I, ch. 3.

I.—*Development of a Valley.*

See Wisconsin Survey Bulletin No. 5, ch. III.

A. Take hypothetical case of newly emerged coastal plain with uniform seaward slope.
   1. Conditions for sheet erosion without valleys.
   2. Concentration of run-off. How secured. Results.
      a. Single slight depression near and at right angles to shore.
   3. Growth of gully in three dimensions: gully-hood to ravine-hood to valley-hood.
   4. Direction of headward growth.
   5. How the valley gets a stream.
   6. Intermittent and permanent streams. Interrupted valley growth in early life; uninterrupted growth later.
   7. Tributaries.
   8. The volume of the stream; conditions determining climate gradient.
   9. Velocity of stream; conditions determining.
   10. The work the stream does.
      a. Transportation.
      b. Corrasion.
      c. Deposition.

II.—*Transportation by Streams.*

See Chamberlin and Salisbury, vol. I, pp. 109-113.

A. How the stream gets its load.
   1. Wears or dissolves it from bed or sides of channel.
   2. Receives it from—
      a. Tributaries.
      b. Side slopes; delivered by wash or gravity.
      c. Wind.

B. How the load is carried.
   1. Mechanically.
      a. Rolled down bottom.
      b. In suspension. How accomplished? A particle dropped again and again.
   2. In solution.

C. Velocity and transporting power; development of law.
   1. Dependent on velocity.
   2. Velocity depends on what?

D. Some examples of amount of material transported by streams.
   1. Mechanically.
   2. In solution.

III.—*Corrasion of Streams.*

See Chamberlin and Salisbury, pp. 113-116.

A. Practical inability of clear water to corrade. Case of Niagara river.

B. The tools of the stream.

C. Rate of corrasion. Discuss as the chief determinants, the influence of—
   1. The character of the rock.
      a. Hardness.
      b. Structure. Consider:
         1. Stratified *versus* massive rocks.
         2. Horizontal *versus* inclined beds.
         3. Inclined beds, the stream flowing (a) with dip, (b) against dip, (c) with strike.
      c. Chemical composition. Solubility.
   2. Velocity of stream.
   3. Load.
      a. Amount.
      b. Character; as shape and hardness.
   4. Stream subject to great and sudden fluctuations *versus* one of nearly constant volume.

IV.—*Erosion Cycle; its Stages.*

See Chamberlin and Salisbury, vol. I, pp. 75-87.

A. Land surface unaffected by streams. Its erosion history unbegun.

B. Topographic youth.
   1. Surface affected by narrow, steep-sided valleys. Lakes and falls often present.
   2. Flats are at this stage the inner-stream uplands.
   3. Narrowing of intervalley uplands.
      a. Wash on valley sides.
      b. General weathering processes on slopes.
      c. Tributaries.

C. Topographic maturity.
   1. Characteristics: Maximum of slope and run-off; hill and valley country. Many more streams than in youth; country completely dissected by erosion lines.
   2. Consider influence upon topography at this stage of—
      a. General altitude of region and nearness to the sea.
      b. Rock structure; horizontal *versus* folded beds.

D. Topographic old age.
   1. Characteristics: Shallow, wide-open valleys. Low, rolling interstream areas. Sluggish, meandering rivers.

E. Final development of—
   1. Pene-plain.
   2. Base-level plain. (This accomplished first near the sea.)

F. The term "cycle of erosion."

V.—*Special Features Resulting from Special Conditions of Erosion.*

A. Bad-lands topography.
  1. Conditions for—
    a. Considerable altitude.
    b. Unindurated rocks.
    c. Generally arid climate, with marked concentration of what rain is received.
    d. Absence of vegetation.
    e. Horizontal strata for best development.
  2. Developed in early mature stage of erosion.
  3. Where formed?

B. Canyons.
  1. Notion of.
  2. Conditions for—
    a. Considerable altitude.
    b. Dry climate.
    c. Running water.
    d. Such a condition of the rocks as will permit their standing in steep walls.

C. Rapids and falls.
  1. General conditions for.
  2. Discuss with diagrams, using horizontal strata, the possible change from rapid to falls to rapids.
  3. Other ways in which falls may develop.
    a. Over fault scarps—Colorado.
    b. When forced to take new course—Niagara.
    c. When streams overflow lava—dams.
    d. Hanging valleys.

D. Narrows.
  1. Determining conditions.
  2. Erosion stage at which conspicuous.

E. Elevation due to differential erosion.
  1. Mesas.
  2. Buttes.
  3. Hogbacks.
  4. Monadnocks.
  5. Plugs, dike ridges, etc.

F. Natural bridges.
  1. Developed in connection with waterfalls.
  2. Developed from caverns.

VI.—*Stream Piracy and Adjustment.*

A. Piracy.
  1. What?
  2. How accomplished? Captor has advantage of deeper valley, due to inequalities of volume, load, or hardness.
  3. Examples. (See "Laboratory Material.")

B. Stream adjustment.
  1. What it means.
    a. Most common in region of folded strata.

VII.—*Effects of Changes of Level.*

A. Uplift.
  1. Equal rise everywhere, coast in same position. Resulting terraces. Resulting longitudinal profile.
  2. Entrenched meanders.
  3. Lengthwise and crosswise valleys.
  4. Pene-plain levels.

B. Subsidence.
  1. Drowned valleys.
    a. All parts of basin sinking equally.
    b. Basin sinking unequally.

VIII.—*Stream Aggradation.*

A. Why a stream deposits. When overloaded due to—
  1. Decrease in gradient.
  2. Decrease in amount of water, due to evaporation, absorption.
  3. Change in shape of channel.
  4. Overloaded by tributaries.
  5. Change in character of material.
  6. Checking of current in flowing into body of standing water.

B. Places of chief deposit by rivers.
  1. At base of steep slopes in its upper course.
  2. On flood-plains.
  3. At the debouchure.

C. Topographic features due to stream deposition.
  1. Cones and fans.
  2. Flood-plain features.
    a. What is a flood-plain?
    b. The deposit over the flood-plain; natural levee.
    c. Meandering of streams; oxbows.
    d. Size of some flood-plains: Mississippi, 50,000 square miles, and average thickness of alluvium, fifty feet.
  3. Deltas.
    a. How formed.
    b. Distribution of deltas.
    c. Why do not all streams have deltas?
    d. Rate of growth.
      1. Determinants. Some examples:
    e. Size of deltas.
      1. Ganges, 50,000 square miles.
      2. Mississippi, 12,000 square miles.
  4. Terraces.
    a. What?
    b. How formed? They result from—
      1. Uplift of basin.
      2. Removal of obstruction.
      3. Normal progress of valley development.
      4. Withdrawal of excess of load.

WORK OF THE WIND.

See Chamberlin and Salisbury, pp. 20-39.

A. Transportation.
  1. How it gets it material.
    a. Picks it up.
    b. Extraterrestrial.
    c. From volcanoes.
  2. How kept in suspension.
    a. Upward currents.
    b. By friction of air.
  3. Distance to which material is carried.
  4. Transportation of dust important wherever—
    a. Strong wind.
    b. Dry surface.
    c. Lack of vegetation.
    d. Earthy matter.
    } Sage-brush plains.

B. Erosion—abrasion.
  1. How?
  2. Where an important agent of erosion?
  3. Topographic results.
    a. Toadstool effects.
    b. Etching out of soft rock.
    c. Polishing and shaping of stones.

C. Deposition.
  1. Dunes.
    a. What?
    b. Where? Wherever dry sand is exposed to the wind.
      1. Shores.
      2. Dry valleys.
      3. Deserts.
    c. How formed? (See Chamberlin and Salisbury, vol. I, p. 24.)
    d. Height of dunes, 200 to 300 feet; 10 to 20 feet commonly.
      1. Strength of wind.
      2. Supply of material.
      3. Size of grains.
    e. Migration of dunes.
      1. How accomplished.
      2. Examples (see Chamberlin and Salisbury, p. 32): (*a*) Burial of orchard in New Jersey; (*b*) church in Germany—1800, 1839, 1869.
      3. How stopped. (Between 1826 and 1838 the government spent $28,000 to fasten dunes on harbor shores of Provincetown, Mass., by beach grass.)
  2. Loess (see Chamberlin and Salisbury, p. 22).
    a. Description; physical character.
    b. Where found. China: Source; thickness, 1000 feet. Europe. United States.
    c. Origin: Wind; sediment of smaller rivers of glacial period.

SHORE-LINES.

See Chamberlin and Salisbury, pp. 326-351.

A. Facts of shore-lines horizontally considered.
  1. Regular.
    a. Straight.
    b. Curved.
  2. Irregular. Types of irregularity.
    a. Reentrance of water.
      1. Large—Hudson bay, etc.
      2. Small—Delaware bay, etc.
    b. Projection of land.
      1. Parallel to the general trend.
      2. Normal to the general trend.
    c. Distribution of—
      1. By continents.
      2. In latitude.
      3. With reference to relief of land.

B. As they are vertically considered.
  1. Low, more often regular, in vertical sense.
  2. High, more often irregular, in vertical sense.

C. Forces at work upon shore-lines.
  1. Diastrophism.
    a. Uplift.
    b. Subsidence.
  2. Gradation.
    a. Degradation.
    b. Aggradation.
      Both phases of work done by winds, rivers, waves and littoral currents, currents (ocean), glaciers, shore ice.
  3. Vulcanism.
    a. Constructive.
    b. Protective.
  4. Above forces usually work in combination of some kind.

D. Conditions affecting the operation of forces.
  1. Strength of waves.
    a. Determinants.
      1. Strength of wind.
      2. Depth of water.
      3. Expanse of water.
    b. Examples.
  2. Concentration of blows. Determined by angle of incidence.
  3. Resistance of rock.
    a. Hardness of.
    b. Structure of. Consider—
      1. Horizontal beds.
      2. Beds dipping seaward.
      3. Much- *versus* little-jointed rocks.
  4. Accessories:
    a. Clear waves ineffective against hard rock; shown by barnacles being as numerous after as before great storms of Outer Hebrides.
    b. Work done by aid of—
      1. Rock fragments.
      2. Air. In cliffs with cracks and joints, waves drive air with prodigious force; its contraction and expansion a powerful agent.
      3. Ice.

E. Shore-line features, resulting from above.
  1. Initial forces resulting from diastrophism.
    a. Uplift—gives regular, simple shore-line.
    b. Subsidence—produces irregular, embayed coast.
  2. The cliff.
    a. Its formation. (See C. and S.)
    b. Declivity of cliff depends on?
    c. The wave-cut terrace.
    d. The wave-cut and built terrace.
    e. Example of rate of retreat of land: Six feet in one year on Nantucket.
  3. The beach of transportation. Develop idea of littoral current.
    a. Origin of shore drift.
      1. From cliffs.
      2. From rivers.
  4. Depositional forms.
    a. Current holds its direction and shore-line during—
      1. Spit.
      2. Hook.
      3. Bar.
      4. Loop.
    b. Barrier on shelving coast.

F. Stages in coast-line development.

G. Application of foregoing to coasts, especially of North America. References:
  1. Topographic Atlas of United States, folio 1.
    a. Fiord coast.
    b. A barrier-beach coast.
  2. United States Geological Survey, Monograph I, ch. II.

PRESENT GLACIERS.

REFERENCES.

1. Chamberlin and Salisbury, ch. 5, esp. pp. 238-253 and 268-286.
2. New Jersey Survey, vol. V, ch. 3, esp. pp. 68-76.
3. Wisconsin Survey, Bulletin V, ch. 5, esp. pp. 73-105.

A. Facts about.
  1. What?
  2. Under what conditions formed?
    a. Where do these conditions obtain?
    b. Snow-line and its position in tropics; in other latitudes—8800 feet in Switzerland.
  3. Transformation of snow into ice. Névé.
  4. Movement of glaciers.
    a. Fact of.
    b. Controlling conditions.
    c. Differential movement.
      1. Mer de Glace, in summer 27 inches in center and 19 inches near sides.
    d. Examples of rate: Swiss glaciers, 1 to 3 inches or 4 inches per day. Greenland, average of edge, 1 inch per week; locally, 50 to 60 feet per day.
  5. Lower limit.
    a. How determined?
    b. Where, with reference to snow-line? In Switzerland 3500 feet below (average). Within 670 feet of sea-level in case of one New Zealand glacier.
    c. Oscillation of end.
      1. Causes.
      2. Examples: Alaska retreating; some Norwegian retreating, some advancing; 35- to 40-year cycle in Switzerland.
  6. Surface features; irregularity.
    a. Due to debris.
    b. Due to unequal melting following cracking.
    c. Change in slope.

B. Types of glaciers.
  1. Ice caps.
    a. Greenland, 300,000 to 400,000 square miles.
    b. Antarctic, 3,000,000 square miles.
  2. Valley glaciers.
    a. Alpine type.
    b. High-latitude type.
  3. Piedmont glaciers.
  4. Cliff glaciers.

C. Work of glaciers.
  1. Kinds of work done.
    a. Transportation.
      1. How load is obtained.
      2. Transportation by ice *versus* by rivers. Moraines: Lateral, medial, and ground.
    b. Erosion.
      1. Tools.
      2. Characteristics of surfaces and rocks worn.
    c. Deposition.
      Ice deposits *versus* water deposits. Moraine; terminal.
  2. Topographic effects.
    a. Shaping of hills; Roche Moutonnée.
    b. V- to U-shaped valleys.
    c. Hanging valleys.
    d. Fiords.
    e. Rock basins, at slopes of mountains, etc.
    f. Depositional features.

PAST GLACIERS.

See Davis, pp. 330-346.

A. General discussion of glacial period.
  1. Centers of dispersal.
  2. Extent of glaciated area.
  3. The glacial period complex; several advances of the ice. Five epochs known.
  4. Driftless area.
  5. Cause of glacial climate.
  6. Time relations. Time since last much shorter than time between first and last.

B. Drift deposits.
  1. Unstratified.
    a. Moraines.
      1. Ground.
      2. Terminal: Where formed? Characteristics.
    b. Drumlins.
  2. Stratified.
    a. Kames.
    b. Eskers.
    c. Outwash plains.
    d. Valley trains.

C. Geographic effects.
  1. Reduce slopes.
    a. Effect on transportation.
    b. Increased arable land.
  2. Modification of soil.
    a. Amount increased.
    b. Physically mixed.
  3. Drainage.
    a. Lakes and marshes.
      1. Lakes, how formed.
    b. Floods diminished.
    c. Water-power.
  4. Change in acreage of land.
    a. Addition. Long Island covers bare rock.
    b. Subtraction. Lakes and marshes.

D. Contrast between glaciated and non-glaciated areas.
  1. Topography—in unglaciated, elevations stand in definite relations to drainage lines.
  2. Drainage—driftless well drained; in drift area, lakes, marshes, and undrained depressions.
  3. Mantle rock.
    a. Thicker in drift.
    b. Physically diverse.
    c. Contact with under rock.

LAKES.

See Chamberlin and Salisbury, pp. 368-374.

A. Origin of basins.
  1. Due to crustal movements.
    a. Depressions are new land surfaces: Southern Florida.
    b. In mountains: Block mountain region of Oregon.
    c. Warped valleys.
    d. Earthquakes: "Sunken country"; Reelfoot lake, Tenn.
  2. Formed by river action.
    a. Oxbows.
    b. Delta lakes: Ponchartrain.
    c. Damming by fan: Tulare; Pepin.
    d. Rapid aggradation by main—ponding back of tributaries: Red river, Louisiana.

A. Origin of basins—*continued.*
  3. Accidents to rivers. Damming by—
    a. Lava flow.
    b. Drift: Finger lakes.
    c. Landslides
  4. Formed by glaciers.
    a. See 3: *b*, above.
    b. Irregular deposition of drift.
    c. Rock basins; ice erosion. Canada, Finland, and western mountains.
    d. Marginal lakes: Agassiz, etc.
  5. Due to waves and currents; back of bars.
  6. Due to work of ground-water. Ponds in sinks.
  7. Due to volcanic action.
    a. See 3: *a*, above.
    b. In caldrons. Crater lakes.

B. Life-history: Short-lived—
  1. Filling.
  2. Cutting down of outlet.
  3. Work of vegetation.
  4. Evaporation.

C. Salt lakes.
  1. Conditions of formation.
  2. Where?
  3. Deposition.

D. Relation to man.
  1. Great area lost to agriculture.
  2. Fertility of old lake floors. (Wheat region of Red River country.)
  3. Prevent destructive floods.
  4. Great Lakes and development of north-central United States.

VOLCANOES.

A. Definition of: "Restricted vent, out of which hot rock material comes."—*Salisbury.*
  1. Essential points.
    a. Vent.
    b. Discharge of hot rock.

B. Facts about.
  1. Types of eruption.
    a. Violent.
    b. Quiet.
  2. Degrees of activity.
    a. Active.
    b. Dormant.
    c. Extinct.
  3. Products.
    a. Lava.
    b. Cinders (scoria).
    c. Ashes.
    d. Vapors and gases. (H_2S, H_2O, CO_2, SO_2, HCl, Cl, S.)
  4. Relations of adjacent vents.
    a. In activity.
    b. In height of lava.
    c. In kinds of material discharged: Vesuvius, Krakatoa, Mauna Loa, Stromboli.
  5. General phenomena.
  6. Destructiveness.
    a. Lava-flows.
    b. Ashes, cinders.
    c. Torrents.
    d. Earthquakes.
    e. Landslides.

B. Facts—*continued.*
  7. Topographic results.
    a. Cones:
      1. Cinder cones: Mauna Loa; diameter 25 times height.
      2. Lava cones: Mount Shasta; diameter 7 times height.
    b. Plateaus.
  8. Number: 300 active; very many cones not yet eroded away.
  9. Distribution:
    a. Continents *versus* islands; one-third of present volcanoes on continents.
    b. Nearness to sea.
    c. Latitude.
    d. In belts or lines.
    e. Mountains.
    f. Moving land.
    g. Young strata.
  10. Physical character.
    a. How stream moves.
    b. Section from top to bottom.
    c. Porphyry, glass, etc. Basaltic structure. Tuff.

C. Volcanoes in past time. No known law governing distribution in time. Periods of greater and lesser energy and number.

D. Eruptions and irruptions not volcanoes proper.
  1. Lava fields.
  2. Laccoliths.
  3. Sills.
  4. Dikes.

E. Cause of valcanoes.
  1. Things to account for.
    a. Heat. Probably 3000° F. at surface.
      1. Primal; four theories.
        (a) "Thin crust" theory.
        (b) This theory postulates—
        (c) That the earth is solid except for "localized enclosures of molten matter" at various depths from the surface.
        (d) That earth is solid throughout, but that rocks at some little distance from the surface are in a "potentially liquid state," kept solid only by the enormous pressure to which they are subjected.
      2. Secondary.
        (a) "Chemical" theory.
    b. Force.
      1. Steam and other gases.
      2. Gravity.
      3. Lateral pressure.

F. Life-history of volcanoes. (See "Volcanoes of North America," by Russell.)

G. Notes on ejecta:
  1. Types of texture in igneous rocks:
    (*a*) Glassy; (*b*) compact; (*c*) porphyritic; (*d*) granitoid; (*e*) pyroclastic.
      See Scott's Geology, pp. 189-191.

EARTHQUAKES.

See Chamberlin and Salisbury, pp. 503-512.

A. What? Tremors of appreciable violence, springing from sources within the earth itself.

B. Where?

C. Frequency. Japan, three or four per day. "Crust of earth is in a perpetual tremor."

D. Phenomena of earthquakes.
  1. Series of elastic waves, spherical.
  2. Amount of actual movement. Fraction of millimeter.
  3. Rate of propagation of wave.
    a. Determining conditions. Elasticity and continuity of rock.
    b. Estimated rate. "Several hundreds to several thousands of feet per second at the surface."
  4. Depth affected.
    a. How position of flows is estimated.
    b. Most originate within 5 to 10 miles of surface.

E. Causes of earthquakes.
  1. Fissuring.
  2. Faulting.
  3. Volcanic explosions.
  4. Avalanches.
  5. Falling in of caverns.
  6. Slipping of material on steep submarine slopes.
    a. On continental shelves (Japan).
    b. On delta front.

F. Effects of earthquakes.
  1. Open up great cracks: India, New Zealand, Japan.
  2. Faults: Owen's valley, Cal., 1872; throw, 20 feet.
    a. Permanent changes of level: Chili, 1822; rose 3 to 4 feet for long distance. Off Greece, submarine fault scarp of 1500 feet.
  3. Form permanent depressions in which lakes sometimes accumulate. Sunken country.
  4. Landslides sometimes dam valleys.
  5. Effect on drainage. Destroy and make springs.
  6. If shock is in sea, sea waves.
  7. Great loss of life: Lisbon, 1755, 60,000; Calabria, 1783, 40,000.

CHANGES OF LEVEL.

A. Method by which any change in relative position of land may be detected. Comparison with sea.

B. Change in relative altitude of land and sea may be due to—
  1. Change in position of land.
  2. Change in sea.
    Can it be told which has occurred?

C. Elevation, proofs of.
  1. Testimony of human erections: Bridges above water in south and west Crete; temple of Serapis; marks on Swedish coast.
  2. Elevated beaches, sea cliffs, etc.: Parts of southern California; east and west coast of Scotland.
  3. Marine shells.
  4. Regular, simple shore-line.

D. Depression, proof of.
  1. Submerged human erections: Drowned buildings in east of Crete; drowned buildings in Greenland.
  2. Buried forests.
  3. Drowned valleys: Hudson.
  4. Coral reefs and atolls.

E. Evidences of movement away from seacoast.
  1. Tilted old beach lines: Iroquois beach, 140 feet above Lake Ontario at Lewiston; 200 to 300 feet near Watertown.
  2. Some terraces.
  3. Interrupted profiles.
  4. Entrenched meanders.

THE GREAT TYPES OF LAND SURFACE.

PLAIN AND PLATEAU.

A. The great types of land surface.

B. Notion of plain, plateau, and mountain.

C. Types of plains.
   1. Large *versus* small.
   2. Flat *versus* rolling.
   3. High *versus* low.
   4. Fertile *versus* infertile.
   5. Moist *versus* dry.
   6. Treeless *versus* forested.
   7. Along coast *versus* away from coast.
      a. Around lakes.
      b. Between mountains.
      c. Along rivers.

D. Different kinds considered.
   1. Coastal plain (Atlantic coastal plain).
      a. Origin.
      b. Soil belts.
      c. Fall line.
   2. River plains.
      a. Due to gradation (Marysville Butte maps).
      b. Due to lateral plantation (Elk Point, Mont., map).
   3. Lake plains.
      a. Around lakes.
      b. Old lake floors (Sierraville, Cal.; Fargo, N. Dak.)
   4. Waste plains.
   5. Glacial plains.
      a. Recently glaciated (Madison sheet, Wisconsin).
      b. More remotely glaciated (Marion sheet, Iowa).
   6. Lava plains.

E. Life-history of plains.

F. Plateaus.
   1. Points of likeness } between plateaus and plains.
   2. Points of difference } between plateaus and plains.
      a. Plateau valleys *versus* plain valleys.
      b. Cliffs characteristic of plateaus.
   3. Stages in plateau development.
      a. Enforce notion that there is no such thing as "old plateau."
      b. Effect on topography of streams. Immediate; final.
      c. Plateau remnants—mesas and buttes.
   4. Man and plateaus.

MOUNTAINS.

A. Mountains in general.
   1. Definition.
   2. Division (Le Conte).
      a. System.
      b. Range.
      c. Ridge: Subordinate part of range, formed—
         1. By separate folds formed at the same time. Parallel folds of Java range.
         2. By faulting.
         3. By erosion.

B. Kinds.
   1. Block (fault)—Oregon.
   2. Folded—Juras.
   3. Domed—Black Hills.

B. Kinds—*continued.*
   4. Volcanic { Massive igneous core—Pike's Peak. / Trap ridges—Tom; Holyoke.
   5. Circumdenudation.

C. Discussion of (each of above).
   1. Origin.
   2. Life-history: Youth, maturity, old age.

D. Influence of mountains on—
   1. Climate.
      a. Elevation and temperature.
      b. Effect of winds.
         1. Mountain and valley breezes (valley breeze, day; mountain, night).
         2. Chinook.
      c. Rainfall: Two sides of Andes; valley of California *versus* Nevada; shores of Wales *versus* valley of Thames.
   2. Economic wealth.
      a. Fissuring.
      b. Exposure of deep deposits by erosion.
   3. Trade routes—Spain.
   4. National boundaries: Eastern or western Europe; Chili and Argentine controversy.
   5. Refuge for weak peoples: Highlands of Scotland; Switzerland.
   6. Influence on history: Alps in early Europe; mountains of Greece; mountains of Italy.
   7. Habits and customs of inhabitants: Language of Wales; customs of North Carolina mountaineers.
   8. Dangers to inhabitants of.
      a. Avalanches. (Forest protection of Switzerland.)
      b. Landslides. (Valley of Ganges.)

E. Topographic maps.
   1. Volcanoes.
      a. Young: Lassen Peak sheet; Mount Taylor.
      b. Older, various stages of demolition: Marysville; Shasta; San Francisco.
      c. Plugs: Crazy mountains, in Little Belt and Livingston folios.
   2. Igneous mountains. Massive igneous cores: Pike's Peak.
   3. Trap ridges: Holyoke (folio).
   4. Folded mountains.
      a. Stevenson, Ala. (folio).
      b. Kingston, Tenn. (folio).
      c. Harper's Ferry, Va. (folio, etc.)

Differences in Erosion between High Altitudes and Low.

F. Moisture.
   1. Often drier—especially in lee of mountain.
   2. Often wetter—especially on windward of mountain.
   3. Differences in form of precipitation. (Mountain streams do their work primarily when snow melts.)
   4. Differences in rate of precipitation.

G. Wind.
   1. Much more effective in high altitudes.

H. Temperatures.
   1. Greater range in higher altitudes.
   2. Much lower average in high altitudes.

I. Differences in vegetation.
   1. Protecting or failing to protect against erosion.

SUGGESTIONS FOR LABORATORY AND FIELD WORK IN PHYSICAL GEOGRAPHY.

Laboratory and field work simply to supplement text and not an end in itself. Laboratory and field work to go hand and hand with text.

ROOM. Any light room fitted with flat-topped tables. Case or set of drawers to keep maps and specimens in. Maps best kept in folders of wrapping-paper.

METHODS. In map work divide class into groups of four. Have maps arranged in duplicate sets, giving one set to each group.

In field work divide into groups of 15 to 20. In all cases teacher must be thoroughly familiar with work before attempting to take class over ground.

RELATION OF FIELD AND LABORATORY WORK TO TEXT. Text three days, field and laboratory work two days, about right proportion. Four to six field trips a year generally sufficient.

TEXT WORK. Teach text thoroughly. Supplement and illustrate by talks and assigned readings when possible. Teacher should be thoroughly familiar with material equivalent to that contained in Salisbury's Physiography or Gilbert & Brigham, Appleton.

Good Reference Books for Teacher.

Salisbury, Physiography, Holt & Co.
Chamberlin and Salisbury, Geology, vol. I, Holt & Co.
Mill, International Geography, Appleton.
Ward, Practical Exercises in Meteorology, Ginn & Co.
Scott, Introduction to Geology.
Norton, Introduction to Geology.
Fairbanks, Physiography.
Brigham, Laboratory Manual Physiography, Appleton.
Thrafton, Laboratory Manual Physiography, Ginn & Co.

(Last five high-school texts, and may possibly be obtained as desk copies.)

LABORATORY WORK.

Map work—

1. Teach meaning of topographic maps. Model may be used.
   Draw ideal contour map, as of conical mountain, etc.
   Draw profiles.
   Examine maps showing mountains, plateaus, and plains.
2. Rivers or running water.
   (*a*) Canyons illustrating downward cutting.
   Meanders illustrating lateral cutting.
   (*b*) Cycle—youth, maturity, old age.
   (*c*) Deposition—deltas, bows, islands, alluvial fans, levees, formation of oxbows, flood-plains, terraces.
   (*d*) Effect of unequal hardness of strata—ridges, hog-backs, mesas, buttes, escarpments.
3. Ground-water. Study general topography of limestone region.
4. Wind work—dunes, erosion (Nebraska).
5. Glaciers—existing.
   erosion—cirques, U valleys, roches moutonnes.
   deposition—moraines, kames, drumlins.
6. Plains — central, pene-plain, lacustrian, flood-plains, waste plains, glacial.
7. Plateaus—erosion, vulcanism, folded, faulted.
   Mountain.
8. Volcanoes—old, young, lava plain.
9. Coast-lines—erosion—sea cliffs, heads.
   deposition—beaches, bars, spits, hooks, loops, ponds, barrier beaches.
   diastrophism—old beach lines.

Identification of: Quartz, calcite, mica, feldspar, galena, gypsum, limestone, sandstone, shale, quartzite, igneous rock.

METEOROLOGICAL.

Observations of:

Date	Temp.	Pressure.	Wind.		Clouds.		Rainfall.	Remarks.
			Dir.	Vel.	Kind.	Amt.		
7-17—8 A. M..	....	....	......	......	....	....	....	....
7-17—2 P. M..	....	....	......	......	....	....	....	....
7-17—8 P. M..	....	....	......	......	....	....	....	....

Study of weather maps:

1. Plot annual mean temperature of United States.
2. Study relation of direction and strength of wind to isobars and quadrants of highs and lows.
3. Relations of isotherms and isobars, highs and lows. Cold wave.
4. Relation of humidity to highs and lows.
5. Direction and rate of movement of highs and lows.

Make forecasts for at least one month, preferably in winter, when storms are more regular.

FIELD WORK.

Things to be seen in Kansas:

Running water: Erosion, deposition.
Weathering of rock and production of soil.
Work of underground water: Water level, sink-holes, springs, flowing wells, wells.
Glacial drift, northeastern part north of Kansas river.
Mountain west.

APPARATUS NECESSARY.

Map work:

Topographic maps: United States Geological Survey.
Mississippi river maps: Mississippi River Commission.
Coast charts: United States Coast and Geodetic Survey.
Geological folios: United States Geological Survey.

Meteorology:

Daily weather maps.
Thermometer.
Barometer.
Blank maps United States Weather Bureau, $1.40 per 1000.

Mineralogical:

Small cabinets containing 30 specimens, labeled and described, may be obtained from dealers for about $2.

NOTE.—For valuable suggestions on the teaching of physiography, with reference especially to field and laboratory work, consult *The Interstate Schoolman* for May, June, and July, 1907, Hutchinson, Kan.

AN OUTLINE FOR A HALF-YEAR'S WORK IN PHYSIOGRAPHY.

I. The earth as a planet.

1. Day and night due to rotation. Shape of the earth indicated by their succession. Size and rate of turning of the earth. Variations in length of day and night explained. Inclination of the earth on its axis, movement in its orbit, and rotation. Day at the equator always 12 hours long. Day at the poles; at the polar circles.
2. Change of seasons. Revolution of the earth about the sun necessary, but not sufficient in itself. Inclination of earth's axis and the parallelism of the same. The one perpendicular ray of the sun to the earth and its path. The equinoxes; solstices. The idea of an equinoctial storm questioned. The orbit of the earth elliptical; the earth nearest the sun about January 1; farthest from the sun in July. Compare the seasons of northern and southern hemispheres in consequence. Observe the variation in the time of sunrise and sunset; the change north or south in the position of the sun. Sketch the position of the earth in its orbit at the time of the change of seasons.
3. The moon. Make drawings to show its changes from quarter to quarter. Its orbital movement. Near-moon and far-moon explained. Apparent movement north and south. Mass and distance of the moon. The moon's equator inclined 6 deg. 39 min. to the ecliptic.
4. The solar system. The sun. Inferior and superior planets. Satellites; meteors; morning and evening stars; the zodiac and its constellations. Nebular hypothesis.

II. The atmosphere.

1. The air is a part of the earth and not a more envelope. Its weight estimated as that of a layer of water covering the earth to a depth of 33 feet. Three-fourths of the atmosphere below the height of Mount Everest. The height to which air extends is shown by meteors to be more than 100 miles. The estimate based upon the aurora borealis is 400 miles. Beyond 620,000 miles the earth's gravity could not hold the gases of the atmosphere.
2. Composition of air. A mechanical mixture of nitrogen, oxygen, carbon dioxid and very small amounts of other gases. Water vapor present in varying quantities. The amount of vapor depends upon temperature. Point of saturation. At freezing-point a cubic foot of air will contain about 2 grains; while at 80 deg. it will hold 12 grains. Absolute and relative humidity. Use of hygrometers. The dew-point. Clouds—classes. Forms assumed by vapor. Dust particles in the air—meteoric; terrestrial. Function of.
3. Pressure of the air. The barometer—construction and use. Different kinds—cistern, siphon, aneroid. Relation of volume to pressure; density; temperature. Height of barometer at sea-level; on Mont Blanc, 15 inches. Variation of barometer, as a rule, is opposite to that of the thermometer. Pressure at thirtieth parallel greater than at the equator. Mixtures of water vapor and air lighter than dry air. Low barometer of the polar regions.
4. Isobars. Connect places of equal pressure during a certain period. Two belts of high pressure passing around the globe,

II. The atmosphere—*continued.*

one on each side of the equator. Between these two a belt of low pressure in the tropical regions. About the poles are two other areas of low pressure. Areas of pressure vary with seasons; different for land and water. Corrections of barometers for height and temperature. How to forecast weather from barometric readings.

5. Temperature of the air. Just as an instrument was necessary to measure the pressure of the air, so with its temperature. The thermometer. The story of its construction. Establishment of freezing- and boiling-points. Kinds of thermometers. "The amount of heat received from the sun 2208 times that received from the interior of the earth." (Haughton.) Heat rays from the sun would pass through the air without loss if it were not for the water vapor in the air. Absorption varies with height of the sun, a vertical beam losing about 20 per cent. of its heating power; the morning and evening beams lose 95 per cent. The loss of heat to the air varies with latitude. The average for England's latitude is 50 per cent., says Thornton. Radiation of heat from the surface of the earth to the air. Influence of water vapor in the air shown by clouds, hindering radiation. Isotherms. Establishment of the heat equator. Vertical and lateral variations of temperature. Snow-line. Influence on plants, timber-line.

6. Movements of the air. Due to variations in pressure; unequal heating of the earth's surface by the sun; amount of water vapor in the air. Illustrated by land- and sea-breezes; how the land and sea vary, both as to insolation and radiation. Mountain and valley winds in mountainous regions. The wind blows up the valley by day and down the valley by night. Explain. Conditions in the torrid zone—vertical rays, large evaporation, surface-temperatures high. Low-pressure equatorial belt. Poleward movement above the up-draught. Doldrums. Trade-winds due to pressure equatorward. Rotation of the earth deflects trade-winds westward. Constant only upon the sea. Returning trades come to earth in the latitudes between 30 deg. and 40 deg. Region called horse-latitudes. Beyond the parallels of 40 deg. N. and S. are the prevailing westerlies, sometimes called the antitrades. Circumpolar whirls. Are monsoons deflected trade-winds? How the orbital movement of the earth causes the wind and calm belts to migrate. Example: In the Atlantic the northeast trades extend from 3 deg. N. to 26 deg. N. in March (vernal equinox) and from 11 deg. N. to 35 deg. N. in September (autumnal equinox). Climatic characteristics of the wind belts. The equatorial belt is sultry, rainy, and marked by diurnal rather than seasonal changes. The trade-wind belts, air is dry, unable to maintain saturation on account of moving into warmer regions and the rainfall light. Constant winds, large evaporation, great saltness of surface waters. The horse-latitudes have light winds, frequent calms, dry air and light rainfall. The westerly winds distinguished by cyclones and anticyclones. Develop a law for the location of deserts. Distinguish between continental and oceanic climates. Local winds. The chinook; foehn; mistral; sirocco; simoon; harmattan; typhoon; tornado; waterspouts; blizzards; hot winds. The cyclone is the most important storm of the middle latitudes. The cause is not clear. They are areas of low pressure and may be due to excessive heating; still, they occur in winter. They may be due to eddies in the edge of the prevailing west-

II. The atmosphere—*continued.*

erlies. They have also been ascribed to magnetic disturbances possibly due to sun-spots. The anticyclone moves in the same direction as the cyclone but is descending air and blows outward. The weather of the United States is so largely influenced by the cyclones and anticyclones that teachers are urged to devote as much time as possible to them. Tropical cyclones compared with the above. Possibly due to strong convection currents. Controlled by prevailing winds.

7. Weather and climate. What determines the weather of a place? The climate is the average weather of a locality. Diversity due to latitude, altitude, distance from the sea, the prevailing winds, the annual rainfall, topography, surface, soil. Describe the instruments used in a meteorological station. Account for the variance between parallels and isotherms. The influence of forests. Regions of rainfall. Oceanic climate; continental; mountain and plateau. Changes of climate. Cycles indicated in Europe and America. Relation of climate to plants and animals; to man.

8. The work of the atmosphere. Dust in the air. Evaporate rainwater or snow and a residue of dust is found. Sources of this dust. By abrasion. From volcanoes. Story of Krakatoa; how brilliant sunsets are seen after eruptions. Loess. Region of the Hoang-ho. Of the Mississippi valley. How dust is retained in the air; upward currents. Removal of dust from lands. Sand. Cannot be taken up by air-currents as dust may be. Moved along the surface of the land. Dunes. Sand supplied by the sea. Atlantic coast; without much sand in region of winds from the land; dunes found where the prevailing wind is from the sea. Migration of dunes. Buried cities of Central Asia. Weathering. Example of iron-rust to show the work of oxygen. Action of carbonic-acid gas upon rock, called carbonation. Hydration. Action of freezing and thawing in breaking up rock. Talus at foot of cliffs. Work of plants and animals as an aid to weathering. Salisbury sums up the work of the atmosphere as tending to lower the surface of the land, and the breaking up of material in preparation for its removal.

9. Life forms in the atmosphere.

III. The hydrosphere. Includes the ocean, seas, lakes, rivers, groundwater, and the water-vapor of the atmosphere. Ocean-basins, epi-continental seas, mediterraneans, all divisions of the hydrosphere. The term sea-level relative, since the waters are attracted by the land masses which rise above them. At the mouth of the Indus river, Salisbury says, the sea-level is 300 feet higher than it is at the island of Ceylon.

1. The topography of the ocean bottom. Greater part flat. Absence of weathering and erosion. Irregularities: Volcanic cones, steep slopes connecting land masses with ocean-basins, valleys, ridges, banks or plateaus.

2. Depths. The average depth of the ocean is put at $2\frac{1}{2}$ miles. The Pacific is the deepest. The greatest depth found is 31,614 feet, near the Ladrone islands. Other notable depths are the Tuscarora, east of Japan; the Aldrich, near New Zealand; off the coast of Chili; and the Blake Deep, near Porto Rico. Explain instruments used in sounding. The deepest water is not over $^1/_{20}$ heavier than equal volumes at the surface.

III. The hydrosphere—*continued.*

3. Volume and mass of the ocean. If all the land were carried into the sea it would raise the water level about 650 feet. The mass or weight is about five times that of the land above the sea. Pressure. Increases at the rate of 1 ton per square inch for every 1000 fathoms vertically below the surface. The average pressure at sea-bottom is $2\frac{1}{2}$ tons to the square inch, although it increases to 5 tons at great depths. The density varies but slightly, but such as it is the compressibility of ocean water keeps the ocean level at 116 feet lower than it would be otherwise. The enormous pressure modifies the animals so that they are invariably dead when brought to the surface.

4. Temperature of the ocean. Varies with depth and with latitude; affected at the surface by diurnal and seasonal changes, by the winds and currents. Lateral variation of temperature. About 86 degrees at the equator, and 80 degrees for nearly all the tropical zone. In polar regions the surface temperature is about 30 degrees F. In the temperate zone the variation in temperature is quite regular, nearly 1 degree F. for 1 degree latitude. The variation for the year is about 10 degrees in this zone. The movement poleward of surface waters raises the temperature for western coasts in the temperate zone, while the equatorward movement of the deep sea impinging upon the eastern shores brings cold water to the surface. In the torrid zone the eastern shores are warmer than the western. Vertical temperature: The sun affects temperatures possibly 500 fathoms. At this depth the average is 40 degrees F. in all latitudes and all seasons. On the ocean floor, at great depths, the temperature is below even 32 degrees F. The freezing-point for salt-water is 28 degrees F. The temperature of enclosed seas varies to a certain distance, and then remains uniform, as 55 degrees in the Mediterranean sea. Ice formed from salt-water expands a little as it freezes and therefore floats. It is called floe-ice. What is pack-ice? Icebergs are broken fragments from glaciers in Arctic lands. About one-sixth of their depth is above water. What isotherms mark the limits of bergs? The average temperature of the entire ocean is about 39 degrees F. It is therefore cold water with warm layers in the tropics. The ice-floe forms in northern Greenland—a shelf of ice, 120 feet wide at times and 30 feet above level of the floe. Ground ice is formed at the bottom of the sea—in the Baltic sea, for example.

5. Movements of ocean water. The creep—from the equator poleward at the surface and from the polar regions equatorward at the bottom. Deflected by rotation. This movement supplies the sea-bottom with oxygen, essential to animal life. Wind-waves: due to friction of moving air; resembles the movement in a field of grain—the waves travel across the field while the grain retrains its place. Parts of waves: crest, trough, height, length, period. Great waves 1500 feet long, with velocity of 60 miles an hour. The motion in waves diminishes rapidly downward. Erosive work of waves produces land-forms, such as cliffs, sea-caves, beaches, spits, and stacks. Currents. These are the most distinct feature of oceanic circulation. In low latitudes the currents flow westward. These are due to the trade winds. Between them flows the return counter-current, due to banking up of waters on the coast of Brazil. The return of the equatorial currents in the temperate zones is due to deflection by shore-lines and by rotation of the earth and by the prevailing westerlies. The Gulf

III. The hydrosphere—*continued.*

Stream and the Japan currents are really due to the equatorial currents. Of late years the theory that these streams controlled the climate of the shores they strike has been stoutly disputed. The poleward movement of warm currents brings about return currents, which, moving equatorward, are known as cold currents. Currents seldom extend deeper than 300 feet. Observe the monsoon direction of the currents of the Indian ocean. Tides, lunar and solar. Called spring tides when the earth, moon and sun are in a direct line. Called neap tides when at right angles. Compare the attraction of the moon and sun. The former is nearly three times the greater when the differential attraction is considered. Diurnal tides—two high and two low. Account for intervals between them. Show the influence of near-sun or -moon and far-sun or -moon upon tides. Bring out annual tides. Tides differ from other movements of ocean water, as they extend to the sea-bottom. The height varies; in the open ocean only 2 or 3 feet; upon the shores they may rise even to 50 feet. Effect of tides upon the earth's rotation. Work done by tides on coasts and in tidal rivers. The great bore of Han Kow. Small tides in lakes called seiches—due to atmospheric pressure.

6. Work of water on land. (1) Ground-water. All the water which falls on the land is disposed of as follows: by the run-off through surface streams, by evaporation, or by percolation. The relative amounts of these three vary according to such conditions as slope, soil, climate, and precipitation rate. That which soaks in descends to a hydrobathic line, the place of which depends upon pressure, temperature and character of rocks. The work done by this underground water is large. Rocks are disintegrated or cemented, and various rocks are dissolved. In connection with interior temperatures geysers may be formed, and thermal or medicinal springs. Give theory for geysers. Land-forms, such as caverns, natural bridges and sink-holes are due to ground-water. Spring-water contains carbon dioxid, and for this reason is able to dissolve various mineral ingredients from the rocks passed through. Some of the chief classes of springs are calcareous, iron, salt, and siliceous. (2) The run-off. Ritter classifies rivers according to age, as young, mature and old. The amount and character of the work done by the streams varies with age. In young rivers, filled, and the course graded. Then the valley is widened, broad flood-plains are established, the head waters are extended by what is called piracy, and meanders are formed. When this work is done, and the system perfected in the tributaries, the river may be said to have reached maturity. From this state it passes into old age, in which the divides are low, the flood-plains broad, and the matter carried forward better dissolved. Sometimes crustal movements occur to revive the old river, to entrench itself more deeply, to extend its tributary valleys, and so establish water-gaps. How streams are influenced by crustal movements is shown in the case of the Hudson, with its submarine gorge, and the dismembering or engrafting of other streams. The flood-plains of large rivers and their deltas, and such extensive alluvial fans as found in the California, indicate the vast modifying power that streams have over the lithosphere. (3) The take-up by evaporation occasions some particular land-forms, such as playas and salinas. They emphasize the climatic conditions and imperfect drainage.

7. Life in the ocean. Life, both animal and vegetable, is most

III. The hydrosphere—*continued.*

abundant in the first hundred fathoms. No plants are found below a half mile. Why is this? Animals decrease in number with depth, although they increase again in the ocean bottom if the cold currents reach the region. There is little life at the bottom of the Mediterranean sea. There are two great divisions of oceanic life: (*a*) Plankton (from the Greek, meaning "I wander"). This includes both animals and plants which are free to move about. This includes microscopic algæ to whales. Some notable ones go to form oozes from their skeletons. These have in life the power to abstract carbonate of lime or silica from the water. (*b*) Benthos ("The bottom of the ocean"). This division includes those attached to or creeping along the sea-bottom. They are found all over the oceanic world. They are dwarfed and delicate, adapted to great pressure and the cold, and many of them are blind. (*c*) Another method of outlining oceanic life is to consider pelagic, littoral and abyssal areas. Pelagic includes all life-forms of the open sea, whether drifting or swimming. Littoral includes the shore proper to the coralline zone of 40 fathoms. The abyssal includes the deep-sea, and contains most of the types of animals from Protozoa up to fishes. The physical characteristics of these three zones are varied and have left their impress upon the areal life. The pelagic, lightly built, delicate, bluish in color, with external organs for drifting and swimming. But there is also distribution of species, which shows that the sea has zones and boundaries like the dry land. The littoral is a vigorous world. Air, water and land meet. Tides flow, waves break, day and night are here, and change of seasons, and the number of life-forms is vast. The abyssal has no light but phosphorescence; the temperature is low and uniform; the pressure is great; there is calm; it has free oxygen and is plantless. (*d*) Fresh-water forms are divided into shore, surface and deep-water forms, and each embraces many plants and animals.

IV. The lithosphere, or solid màss of the planet.

1. The interior of the earth. Theories regarding it: (*a*) A shell from forty to several hundred miles thick, interior a molten mass; an objection to this theory is that the earth does not act as a fluid mass under the stress of the attraction of the moon and sun. (*b*) That the earth cooled at the center first by conduction, at the surface by radiation. This would imply an unsolidified part between the crust and the center. If volcanoes were sourced in this layer their eruptions would occur at the same time. (*c*) That the earth is solid throughout. The central mass is potentially liquid. Remove the pressure and the matter beneath becomes liquid. This last theory is in favor at present.
2. Secular movements of the earth's crust. (Seculum, "a generation, age.") Sometimes called diastrophism. Elevation: Raised beaches are found several hundred feet above sea-level. Near Valparaiso Darwin found one 1300 feet above the sea. In Scotland beaches are found at various levels, indicating periods of crustal movement. Subsidence: Submerged forests, encroachments of sea upon land; fiords of Scotland. Cause of crustal movements probably due to contraction of the earth's interior and consequent adjustment of the crust. Coast-lines, divided into two classes in consequence of secular movements—those of the first class, or rising coasts, and those of the second class, or sinking coasts. An example of the first

IV. The lithosphere—*continued.*

is that near Buenos Ayres. With on-shore winds this coast is favorable for the formation of sand-reefs, and is not so good for commerce as otherwise. Cliffs are not usual on these shores, but where tidal action is strong they may develop cliffs. Shore-lines of the second class are irregular: such as Norway's fiords occur on these coasts if glacial conditions have obtained. The action of the hydrosphere upon the borders of the lands brings about such land forms as cliffs, stacks, beaches, and land-tied islands. Coastal platforms are due to these agencies. Coast-lines are also affected by climatic conditions: as the mangrove on the mud-flats of Florida and the coral growths where the temperature of the water is as much as 68 deg. F.

3. Mountains, plains, and plateaus. The origin of mountains. Block mountains, such as the Stein mountains in Oregon; folded mountains, as the Jura; domed, the Black Hills. By erosion, circumdenudation and degradation in different forms. Distribution of mountains. Topographic features; systems, ranges, peaks, valleys; characteristics due to age and weathering, as subdued, worn down, or piedmont regions. Influence upon people: Isolation; barriers to commerce; control of occupations. Instances in history. Control of climate. Plains and plateaus. Have they been lifted up in place or has the region been degraded to their level? How plains and plateaus are modified. Activities at work upon them. Coastal plains. How formed. Arrangement of parts. Classes of. Cuestas. Influence upon people.
4. Vulcanism. Theories for volcanoes. See theory (*c*) under discussion of the interior of the earth. Distribution. About twelve regions of activity. Classes; phenomena; topographic results. Earthquakes. Theory for. Probably due to faulting of earth's crust. Instruments for measuring intensity of shocks. Topographic results.
5. Activities bringing about changes on the lands. (*a*) Atmospheric: winds; temperature. (*b*) Hydrospheric: rain; different forms of vapor, as snow, hail, fog, etc. (*c*) Biospheric: work of plants and animals upon the land. Conditions produced by these activities: due to removal of soil; to weathering; deserts; atolls. Making of soil. Soil: primary division, local and transported. Local soils often named for origin, as granitic, limestone, etc. Transported soils named for agency by which they were moved, as glacial or æolian soils; or from their position, as terrace soils; or from other characteristics, as sandy or clayey. A loam is usually defined as a mixture of sandy or clayey soils with more or less organic matter. Other names are peat, muck, loess, marl, etc. Subsoil is that part which underlies the soil proper, from which it differs in compactness and less amount of oxidation and decomposition. When impervious, it is called hard-pan. The color of the soil is due to carbonaceous matter or iron oxids. The first gives color to prairie and swamp soil, and the iron oxids give buff, yellow and red hues. Granite and gneiss also give rise to red and yellow soils. The age of soils extends to first rocks pushed above the hydrosphere, although not until the carboniferous period do we find soils preserved in place and form. Various forms of plant and animal life aid in the making of soils. The ant does a great deal of work; the crawfish and the earth-worm also. The prairie-dog, badgers, and the woodchuck, by burrowing, give passage for water into the soil.

IV. The lithosphere—*continued.*

The action of plant life, such as swamp life, mosses, heat, shrubs and trees aid in formation of soil by allowing water to penetrate more deeply, and by chemical action.

6. Life-forms on the land. Review the previous work with the idea of emphasizing the various activities which bring about conditions, as of temperature, humidity, aridity, fertility, or sterility. Life-forms adapted to environment. Wallace's six main regions. (1) Palæarctic (Europe, northern Africa, northern and central Asia); (2) Ethiopian (Africa south of the Atlas mountains, and Madagascar); (3) Oriental (India, southeastern Asia and part of Malay archipelago); (4) Australian (Australia, with New Guinea, New Zealand, and Polynesia); (5) Nearctic (America as far south as Mexico); and (6) Neotropical (Central and South America, and the West Indies). The above grouping is based largely upon birds and mammals. For plants, the simplest system, perhaps, is Drude's, which consists of three main ones—boreal, austral, and tropical—with fourteen smaller regions. Mankind: a distinct zoölogical genus: four varieties, corresponding to the four main continental divisions of the earth. Earliest human remains found on the Solo river in Java, in Pliocene deposits. Migrations in the Pleistocene age passed through Asia into America, Europe and Africa. Once there climate, soil, diet, heredity and time have modified them. Occupation arising from location made them hunters, fishers, herders, or tillers of the soil. They passed successively through the stone age, metal ages, with advent of letters into the historic age. The primary divisions of mankind are Ethiopic, Mongolic, American and Caucasic—in all, over one and a half billion beings. The position of these people in civilization indicates the degree to which they have arrived in availing themselves through institutions of the conditions resulting from the activities of air, vapor, and soil, all of which, according to Arrhenius, the Swedish savant, arise from solar radiation.

In making this outline no claim is made for originality, either as to content, theory, or outline. The aim has been to put into the hands of the teachers of the subject the leading principles of physiography. There is probably included more than any teacher could use, with attention to detail, in the time suggested, but it is believed that the work may be well covered in the main in a half-year.

Among text-books, one will find a number of most excellent ones. Davis's Physical Geography, Dryer's, Salisbury's (new), Tarr's, Houston's, and Gilbert and Brigham's, Thornton's and Morgan's Physiographies, material from all of which has been taken for this tentative outline, are all good texts. As reference-books especially to be recommended are Mill's International Geography, Geikie's Earth Sculpture, and Salisbury's Complete Physiography.

Group V.

BIOLOGICAL SCIENCES.

BOTANY. *One unit.*

THE FUNCTION OF BOTANICAL INSTRUCTION. In common with other studies, botany affords training in observation and reasoning, and in planning the course this must be kept sight of in method and matter; and it is the function of an elementary course of botany also to give an exact knowledge of the most important facts about the nature of plants. The very fact that we are absolutely dependent on plants for our existence, and that they strongly influence our lives in many ways, establishes for botany a natural place in the list of the most important studies offered in the secondary schools. It should be the aim of botanical instruction in these schools not to make botanists, but to disseminate knowledge of how plants are constructed, how they get their living, how they react to their environment in a way helpful to them, what their place in nature is, and how they help us and how we may help them. The story of plants has an esthetic and a practical side. Almost any fundamental fact about plants bears on both sides; it enhances our appreciation of plants, and helps us to deal with them more intelligently. This, in a word, it is the part of botanical instruction in the secondary schools to accomplish.

THE METHOD. Primarily the plants themselves are to be studied, and only secondarily what somebody says about them. The study is to be exact, detailed, and thoughtful; not hurried, cursory, and without satisfying application and conclusion. The problem of supplying materials for a year's course is simple enough if the work is thoroughly done; but if the pupils are allowed to skip hurriedly from subject to subject, the materials for a year's course will have been gone over in a month, the pupils will have acquired no good in training or knowledge, and the teacher will complain that it is impossible to offer a year's course in the secondary schools. To insure the right sort of work the pupils are to make neat and exact drawings and intelligent notes for each subject worked out in the laboratory. The drawings are to be made with a hard drawing-pencil (6-H Koh-I-Noor is the most satisfactory), on heavy, unruled linen ledger paper. The notes, written in ink, are to face the drawings, so that drawings and notes can be compared without turning the page. The notes should be on separate sheets, and not on the backs of the drawings. Both drawings and notes are to be placed symmetrically on the pages. Before beginning a page of drawings, it is to be determined how many are to go on that page and where they are to be placed, so that when the pages are completed they will be pleasing in their symmetry. The drawings are to be simple outlines, done with care, so that they are distinct, neat, and in right proportion. When the pages are done—drawings and notes—they are to show intelligently and truthfully what the pupil should learn from his subject, and they should be pleasing to look at. Inexact and slovenly work is an abomination, and worse than nothing. To let such work pass is to do the pupil an injury.

Why require drawings when so much time is consumed in their making? Because they are the most exact and the simplest mode of expression in the study of form and structure. Pupils who think they cannot draw can yet express themselves about form and structure better in that way than in spoken or written language. Again, when drawings are to

be made, the pupil becomes a more exact observer. The notes are to tell what the parts of the drawings are, how the materials are prepared for study, and what facts of plant life—structural, physiological, or ecological—have been learned. They should show that the pupil has been thinking about his work and sees its meaning. To insure that all this be well done the laboratory book must be gone over by the teacher at frequent intervals, and its defects discussed with the pupil, and the necessary improvement insisted on before a passing grade is obtained. In being thus guided with a firm hand the pupils are apt to like their work better and are sure to respect it.

Whenever possible, physiological experiments should accompany the laboratory work on form and structure. These may be prepared by the teacher, or they may be assigned to groups of pupils for demonstration before the entire class. Directions for such experiments will be found in some of the books cited below. Form and structure dissociated from physiological function or adaptation to the outer world are the mere husks of botany, and as soon as learned they are to be followed by an inquiry into their reason for being. Studied in this way, botany is a subject of intense interest to any one who wants to know what and how God hath wrought. Happily physiological experimentation is within the possibilities of any school, for the necessary apparatus is simple and can be arranged by teacher or pupils.

Field excursions are a good thing. The teacher should take out not more than eight or ten pupils at a time. He should go over the ground beforehand and become familiar with the problems that can be worked out in the locality to be visited. In the laboratory, form, structure and function are learned to best advantage, and in the field, adaptation to the outer world, and distribution. Therefore field-work becomes necessary to a properly rounded course. But it should be genuine and definite work, and not merely a pleasure excursion. To insure successful field-work the teacher must be familiar with the ground to be traversed, must have put definite problems before the pupils, with a plan for their execution, and must have only a small group of pupils to supervise.

The time devoted to botany, including laboratory work, recitations, and discussions, but not preparation for recitations, should be not less than five hours per week. Where the periods are less than one hour, as in most instances, the pupils should be required to complete the time at other hours. This is justifiable, since the preparation for recitations does not require as much time as other studies, two recitations per week being all that would be necessary.

EQUIPMENT. The first requisite is a well-prepared and enthusiastic teacher. When a teacher with little or no preparation is made to teach botany as a side issue it is an injustice to the teacher, the pupils, and the subject. It were far better not to offer the subject at all under such conditions. It may be stated as a general rule that to be well prepared the teacher should have worked through the equivalent of the botany courses I to V, inclusive, in the University catalogue for 1906-'07, namely, courses in elementary general morphology, plant histology, cryptogamic botany, experimental plant physiology, and systematic botany. With such preparation, the right sort of a teacher is bound to make a success of his course, no matter how poor the laboratory equipment may be. But a good laboratory equipment is a great help, and so inexpensive that no school need be without it. There should be flat-topped tables, about thirty inches high, affording elbow room for each pupil, placed before windows, so as to get plenty of light. Each pupil is to have a good magnifier mounted on a block, so as to leave both hands free for the use of dissecting needles. The doublet magnifiers of three-fourths-inch focus manufactured by Bausch & Lomb, Rochester, N. Y., or by the Spencer Lens Company, Buffalo, N. Y., are satisfactory. The blocks may be made as described in Stevens's Introduction to Botany, page 371. The Barnes dissecting microscopes, made by Bausch & Lomb, and listed at $2.50, but subject to discount, will answer every purpose. Each pupil is to have two

dissecting needles (easily made by thrusting strong needles into soft wood handles), and a sharp pocket-knife. This completes the apparatus needed by each pupil.

The laboratory should have at least one compound microscope for the demonstration of minute anatomy. More of these, if it can be afforded, would be highly desirable. The Bausch & Lomb BB4 special, and the Spencer No. 50 E, compound-microscope outfits, sold to schools at approximately thirty-five dollars, fill all requirements. There are cheaper outfits supplied by these companies and other dealers. Even the cheapest outfits of the Bausch & Lomb and Spencer companies, catalogued as A 1 and 80 A, respectively, costing schools approximately ten dollars, would prove very useful. The laboratory should own a Spencer table microtome for hand-sectioning and a sectioning razor, together costing schools ten dollars. Information about the necessary stains, reagents, etc., will be found in some of the books cited below. If the school can afford it, the laboratory could be more completely equipped as advised in Ganong's Teaching Botanist, mentioned in the book-list below.

In carrying out a course logical in sequence, such as that outlined below, some facilities for preparing materials must be provided. First of all, there should be a room, or part of a room, kept warm enough for germinating seeds successfully, provided with rough boxes filled with white pine sawdust for seed-beds, and jars holding water in which branches of woody plants can be forced into leaf and blossom when needed. Of course, seeds could be germinated in the garden in the summer, and the seedlings in different stages of germination could be preserved in two per cent. formalin. An abundance could be prepared in this way and kept for use in case the plantings indoors should fail. Fresh materials are always best and most agreeable to work with. Some schools use successfully the basement furnace-room for this purpose, and any basement room will do that can be kept warm enough. Then there should be a cupboard in which seeds and fruits gathered during the summer to illustrate dissemination can be stored in boxes away from mice, and in which Mason jars containing two per cent. formalin (one part of commercial formalin to twenty parts of water), or equal parts of alcohol, glycerin and water, for preserving flowers and parts of plants for sectioning, can be kept handy and safe from breakage. A general might as well attempt a campaign without ammunition as a teacher a course in botany without having planned to supply the necessary materials for study in abundance, at the right time, and in suitable condition. Directions for providing materials will be found in detail in Ganong's Teaching Botanist and Stevens's Introduction to Botany.

THE COURSE. In planning the course two questions chiefly must be considered: What subjects will give the best enlightenment about plants in the brief time of an elementary course? And what materials is it practicable for the secondary schools to provide for laboratory study in abundance throughout the school year? Happily these are not conflicting problems. Their solution is found in the following sequence of subjects:

1. *Seeds and Seedlings.* Study Lima bean, castor-bean, and Indian corn, dry, soaked, and in different stages of germination. A seed is a plant in its simplest terms, and affords a logical beginning. The pupil is to learn what a seed is, what its purpose is, what its different parts are for, and how they perform their functions during the resting period of the seed and during germination.

In the food stored in seeds he learns what sorts of materials constitute the real food of plants. In watching what becomes of this food during germination he learns about digestion and the assimilation of food into new plant substances. By simple experiments with germinating seeds he learns the conditions necessary to growth, and about respiration. In watching the parts of the seedling find their wonted directions of growth, no matter in what position the seed lies, and with simple experiments to bring out further information, he learns that plants are

sensible to outer influences, and respond in a way to accomplish for themselves the most good. By comparing the different types of seeds and their variations of habit in germination he learns how plants of different kinds work out the problems of their existence in ways dissimilar in detail but alike in general result. With this much accomplished the pupil has made a good beginning in method, knowledge, and awakened interest.

2. *Roots.* Study the definite order of outgrowth of lateral roots from the main root of seedlings, and the indefinite order of succeeding rootlets. Study root-hairs on seedlings grown on moist blotting-paper or in any suitable moist chamber, or grown in fine soil in a bottle, inclined so the roots will grow along the side of the bottle where they will be in plain sight. Demonstrate with a compound microscope the cellular structure of roots in cross and longitudinal sections, calling particular attention to the tracheal tubes through which the water rises in the plant. Demonstrate the rise of water by osmosis in an artificial apparatus. Demonstrate the attraction of roots by moisture. The pupil is to learn the function of roots in fixation, absorption, and conduction; the nature of root-hairs, and how admirably they are adapted to fit into the small interstices of the soil and put themselves in close contact with its finest particles, so as to absorb the films of water about them and the minerals in solution. He is to learn here what the plasmatic membrane is and how it keeps the important substances of the cell-sap from becoming lost into the soil while permitting the entrance of water and dissolved substances. He is to study the formation of adventitious roots in cuttings, and their value in the propagation of plants. He is to learn about roots used for storage, the roots of parasites, as in dodder, and the roots of air plants. He is to learn about the nature of the soil and what needful materials plants take from it, and the great extent and depth which some roots have.

3. *Buds and Stems.* Study young branches, with buds in their winter condition, of horse-chestnut, cottonwood, and lilac. Horse-chestnut is particularly fine; but if it cannot be obtained, hickory may take its place. Study these buds in various stages of unfolding, having forced their growth in jars of water in a warm room. Study leaves in embryo in the bud, and note their behavior as they grow to maturity, and try to find good reasons for everything observed. Study position of leaves on the stem, and their relation to lateral buds, and the age of the stem on which they are found. Demonstrate the cellular anatomy of stems in cross and longitudinal sections. Learn the functions of the different zones of tissues in bark and wood. Learn the nature of a ring of growth and the purpose of its two zones of early and late growth. Examine the cellular structure of a stem of a monocotyledonous plant, such as corn. Study experiments to show the rise of water through the wood and the circulation of elaborated food through the inner bark. Study the use of buds and cuttings in plant propagation. Proceeding in this order, the pupil learns the nature of a shoot (stem and leaves) in its embryonic condition in the bud, and how the favorable conditions of spring are quickly used to advantage by having the parts which are to grow forth already formed in a miniature the previous season. He learns the admirable plan of packing these parts away within the small compass of a bud, and protecting them by means of scales, hairs, resinous substances, etc. He learns that there is a double highway for the conduction of materials in plants, and he should think this over and find the wisdom in it. The "ring of growth" is no longer a mere phrase, but answers a physiological necessity. He learns that the qualities of a plant may reside in every small part of it, so that a single bud can transmit faithfully all that a plant is, and so be one of the most important means of propagation; and he should see how the habits and mode of life of plants demand this. By a comparison of the cellular anatomy of dicotyledonous and monocotyledonous stems he learns how plants have solved the problem of increase in diameter and provision for strength and the transportation of materials after two distinct plans; to best advantage, however,

evidently in the dicotyledonous plan, since a vastly greater variety of such plants have succeeded as trees.

4. *Leaves.* Study leaves of different shapes and sizes, and, wherever possible, see how form, size, angular divergence and vertical distances apart are correlated with the size and habit of the plant and the place in which it grows. Study the positions which leaves take with reference to the incident light, including such a variety of positions as shown by the elm, maple, cottonwood, Solomon's seal, grasses, and compass plants. Determine whether these different positions are equally advantageous, and whether there is not an ideal position that would serve best in all cases. Determine by experiment what light has to do with the directions which leaves assume. Study the cellular anatomy of a leaf; the epidermis with its stomata and its imperviousness to water; the palisade and spongy parenchyma with their chloroplasts, the intercellular spaces, and the vascular bundles of veins. Compare the starch content of leaves that have been kept in the dark with that of those which have been kept in the light. Study the starch content of leaves that have been kept in the light in an atmosphere devoid of carbon dioxid, and of leaves kept in the light with stomata artificially closed. Confine leaves under glass jars, and study the effect on the oxygen and carbon-dioxid content of the jars when kept in the light, and again in the dark. Demonstrate the transpiration of water by the leaves. Compare leaves of ordinary land plants, desert plants, and water plants, and determine the reasons for their chief differences. The pupil learns that the leaf is the part of the plant which has the manufacture of the plant's food as its chief function. He learns how carbon dioxid is used in this process, and the fact that the sunlight supplies the necessary energy; he learns that leaves breathe (it is not implied that the other parts of plants do not breathe, for they do), and that the water absorbed by the roots is given off by them. He understands, when he compares the cellular anatomy with the particular function of each part, the wonderful structural adaptation to the energy and materials to be used and the work to be done. He learns that leaves are able to perceive the direction of the source of light and to respond to it in a useful way. In studying the different kinds of leaves he perceives the fact of great variability, one of the most important facts in nature. In comparing the leaves of ordinary land plants, desert plants, and water plants, he learns of the power of plants to modify the forms and character of their members in a way that is directly adaptive to their environment, another of the most important facts in nature.

5. *Growth and Movement.* With a compound microscope demonstrate the embryonic condition of the cells at the apex of an onion root, and show how these become changed into permanent tissues of the bark and wood farther back in the older portions of the root. Learn the processes of nuclear and cell division and the evident significance of the great care taken. Demonstrate regions of continued growth in dicotyledonous plants and grasses. Demonstrate the effect of different intensities of light on growth. Determine the relation of the cambium ring to the additions to wood and bark. Study under different conditions the behavior of the leaves of sensitive-plant seedlings grown under bell jars ventilated at the bottom. Study the behavior of twining plants and sensitive tendrils. Read about other cases of sensitiveness in plants. It will be noted that most of this work consists of demonstrations before the entire class. While the subject of growth and movement as here outlined does not consume much time, it is yet one of the most important in plant study. The pupil is introduced to the wonderful facts of cell multiplication, and differentiation from a common origin into various forms to meet different functions. He will find it interesting and instructive to speculate why plants continue to increase in size just where they do and not otherwheres. He has learned more about the sensitiveness of plants to the outer world and their ability to respond to their perceptions in a useful way. He is now prepared to see that plants are endowed with something little short of intelligence.

6. *Modified Parts.* Study roots, stems, and leaves that have been modified so as to perform other than their usual functions; thus, the thorns of wild crab, hedge, and honey-locust; sweet and Irish potatoes; the onion; the tendrils of wild smilax and garden pea; all of the vegetative parts of greenhouse smilax and garden asparagus. Here the pupil learns more about the plasticity of plants in molding the forms of their members to meet specific requirements, and the capacity of plants to vary for known or unknown reasons, and he is in a position to understand better how the great diversity of plant forms has come about. In applying the lines of evidence which he must follow in determining whether unusual forms are roots, stems, leaves, or something else, he is getting good training in careful observation and logical conclusion.

The work thus far outlined, done with the care suggested under "Method," begun at the opening of school in the fall, will not be completed long before the flowers of early spring appear. We are now ready to take up the study of flowers, and the gap can be supplied with flowers that hold their form well in formalin, such as the yucca, asclepias, trumpet-creeper, and Compositæ of the sunflower sorts. It will be noted that the material needed for the course up to this point is such as can be provided right along through the winter with the most ordinary facilities.

7. *Flowers.* Study first flowers of simple construction, such as the yucca, dog's-tooth violet, anemone, and shepherd's-purse. Then select flowers of more complex construction, which have been adapted to protect pollen and nectar and to assist in cross-pollination, such as asclepias, larkspur, iris, and violet. Then study several species of a genus, several genera of a family, and typical species of closely allied families, to bring out the evidences of relationship and the grounds for classification. The object is not to work over as many flowers as possible, but to select a few with a definite purpose in each case. The teacher should see that the leading questions properly pertaining to each flower selected have been asked and answered. The teacher will find many useful suggestions in Müller's Fertilization of Flowers and Kerner and Oliver's Natural History of Plants. With diagrams make clear the process of fertilization and the results. Discuss the benefits of cross-fertilization, and in this light interpret the frequent elaborate devices to secure it. Besides the drawings of dissections, have the pupils make cross and longitudinal diagrams of the flowers to bring out the main structural facts clearly. Go over the evidence about the evolution of a flower from its simpler representatives in the lower plants. The pupil learns what a flower is and how its different parts are adapted to their functions. He learns the wonderful relation of insects to flowers, and how many flowers have adapted themselves to this relationship by modifications of form, etc. And so the evidence is accumulating for him that plants are not cast in rigid molds, but are responsive and adaptive to various influences of the outer world. He learns that there is a real blood relationship between plants differing in general appearance, and that, although there is no written book of lineage for them, the evidence of relationship is by no means obscure and furnishes the ground for classification. He learns the essential facts about sex, the same in plants as in animals, and the use of sex differences in bringing about a more vigorous offspring, and as a means of variation. With this knowledge he has a foundation for an understanding of scientific plant-breeding, which is now being perfected in the experimental stations and is proving of untold advantage to agriculture. Thus his appreciation of flowers is definite and increased many fold.

8. *Distribution of Fruits and Seeds.* Study special devices for scattering seeds, by means of the elastic action of carpels and ways of that kind, or by outgrowths from the seeds themselves in the form of hooks, hairs, or wings. Study fruits that have devices to aid distribution, such as fleshy and nut-like fruits, and fruits with hooks, parachutes, and wings, etc. Determine in each case what part of the seed or fruit fur-

nishes the device. For this work material must have been put up in formalin or dry in boxes the previous summer or fall. The pupil learns the efforts which plants have themselves made to secure dissemination. He learns that they have been able to attain the same end in a great variety of ways; that they have modified various of their own parts, and pressed into service different kinds of outside agents. The evidence of the completeness of the adjustment of plants to their environment has been accumulating before the pupil throughout the entire course.

9. *Algæ, Fungi, Mosses, Ferns.* The work in these subjects cannot be so thorough as in the previous ones, because the time will not permit, and the equipment in compound microscopes will in all probability not be sufficient. But the pupil must not leave the subject of botany without some exact knowledge of these lower plants. Study with the naked eye, simple magnifiers, and as much as possible with a compound microscope, algæ growing in ponds, watering-troughs, etc., and on the north sides of trees; bread mold, wheat rust, and toadstools; moses bearing capsules; ferns with sporangia, and their prothallia. Even with this cursory study a great deal will be cleared up that before was obscure to the pupil. In the study of the algæ the pupil learns by what simple forms an independent existence can be carried on, and he sees in them the possibly very early progenitors of the highest forms of the present day. He learns about the simplest mode of multiplication by the division of a parent cell, and possibly his material will show the formation of spores. In the fungi he learns about the peculiar habit of parasitism or saprophytism. He sees in them the apparently degenerate descendants of the algæ that have lost their chlorophyll, and consequently their independence, or it may be that they gave up their independence and lost their chlorophyll as a penalty. He learns that these forms of life cause the destruction of organic substances and disease in living organisms. In the study of fungi the bacteria and their activities should also be considered. In the study of mosses he sees the first efforts at the differentiation of the plant body into roots and leaf-bearing stems, but with true roots not yet evolved. He sees the very simplest forms of leaves, which are, nevertheless, efficient food-makers. In the ferns the pupil finds a more successful attempt to differentiate the plant body into roots, stems, and leaves. He sees a clear case of the wonderful habit of alternation of generations, which is present but obscure in the mosses, and present and still more obscure in the higher plants. The teacher will use his own judgment about attempting to relate the story of alternation of generations and its apparent significance in the study of evolution. It is one of the wonderful things about plant life, and of great use as evidence of relationship between the lower and higher forms. But it is an unusually difficult subject, and unless thoroughly exploited is apt to lead only to confusion. Still, it would seem too bad to pass so close to a wonderful fact and leave it untouched.

This will end the year's course. It will be seen that it is full of hard work and requires a wide-awake mind. But we expect this of any study that is worth while. Having gone through it thoroughly the pupil's horizon will have been immensely broadened and his interest in the world about him enhanced.

There seems to be the absurdity abroad, even among some school-teachers, that the study of botany in the high schools should be made easy—a sort of gentle wafting of the pupils on beds of roses into a more or less sentimental appreciation of form, color, and fragrance, and the like. This seems to be a product of the fairy-tale sort of nature study which gives a cheap representation of what, as it stands uncolored, is already marvelous beyond conception.

It is this fictitious sort of botany, without any care for the exact truth, and without purpose or logical sequence in its methods, and unexacting of those who study it, that has brought the real science into disrepute among serious people, and kept it from taking its rightful place by the

side of language and mathematics as affording the right sort of training and a worthy body of knowledge.

10. *Helpful Books.* There is one book that stands preeminent in its helpfulness to teachers: The Teaching Botanist, by William F. Ganong, published by The Macmillan Company, New York. In it a sufficiently complete list of botanical books will be found. A more recent and very useful book to the teacher is Lloyd and Bigelow's book on the teaching of biology, in which both botany and zoölogy are treated. Some other books should be mentioned here. Müller's Fertilization of Flowers, The Macmillan Company, is an indispensable help in the study of flowers. Kerner and Oliver's Natural History of Plants, Henry Holt & Co., New York, is replete with information about all phases of plant study; this should be in every school library. Geddes's Chapters in Modern Botany, Charles Scribner's Sons, New York, is a series of very interesting essays in the modern scientific spirit. Barnes's Plant Life, Henry Holt & Co., is a clear and logical presentation of the subject from the standpoint of the relation of form to function. A Text-book of Botany, by Strasburger Noll, Schenck, and Schimper, is written by specialists in its different parts, and is one of the most satisfactory texts yet published. This is issued by The Macmillan Company. Ganong's Plant Physiology, Henry Holt & Co., contains explicit directions for carrying out the experiments demanded in the above course. Stevens's Introduction to Botany, D. C. Heath & Co., Boston, contains detailed directions for carrying on such a course as is outlined above. Osterhout's Experiments with Plants, The Macmillan Company, is replete with ingenious experiments that can be carried on in any school. The series of Bergen's Botanys, issued by Ginn & Co., stands in the front rank of botanical texts. Peirce's Plant Physiology, Henry Holt & Co., contains a clear and up-to-date summary of our knowledge of physiological processes. Green's Vegetable Physiology, and Stevens's Plant Histology, published by P. Blakiston's Son & Co., Philadelphia, will be found useful additions to the school library. Carlton's Nature and Development of Plants, Henry Holt & Co., is replete with information needful to the teacher. Chamberlain's Methods in Plant Histology, issued by the University of Chicago Press, is an excellent guide to histological technique. Professor Coulter's books, Plant Relations and Plant Structures, beautifully written and illustrated, issued by D. Appleton & Co., New York, should be in every school library.

ZOÖLOGY. *One unit.*

The growing importance of the biological sciences in both the high-school and college curricula makes necessary, so far as possible, the establishment of some standard which shall serve to coördinate the work of the different schools of the state. In addition to thus outlining a course of study, there will be included suggestions regarding laboratories, apparatus, and materials, which, it is hoped, may be of service. This is done because numerous letters received from the teachers of zoölogy throughout the state indicate the desire for assistance of this sort. It is the wish of the department of zoölogy at the University to be of service to the other public schools of the state in carrying on the work with which it is concerned, and it is hoped that the teachers of the secondary schools will come into as close touch as possible with the department and its instructors.

PURPOSE OF THE COURSE. There is hardly any necessity for saying that, in making the suggestions regarding the high-school course of zoölogy that follow, the main thought kept in mind has been, not what would be best for the student who wishes to continue the subject at the University, but what will give him the best sort of training in that province of learning which it is the peculiar privilege of the observational sciences to occupy. And in this connection it may here be observed that the best teachers of these sciences do not regard the ele-

mentary courses as primarily designed for affording information, but rather as a means for training the mind to observe facts and to arrange and present these in a clear and logical manner.

CHARACTER AND EQUIPMENT OF THE LABORATORY. Obviously there can be no training of this sort by means of mere text-book work, and so it may be said in the beginning that the prime necessity of a course is a direct study of the animals themselves. This necessitates a laboratory and suitable equipment. Regarding the room, it may be said that it is almost necessary to have it arranged so that it may be used for the one purpose alone, and to have it provided with tables rather than with desks. These need not be expensive, since the common kitchen table serves very well. Numerous windows are an advantage, and they are best situated on the north side. So far as general laboratory equipment is concerned it may be very simple. There will need to be receptacles for holding the specimens, and for this purpose stone jars of four or five gallons capacity serve excellently. Then some aquaria for live material are needed. These may be purchased at reasonable prices, but in their absence candy jars, fruit jars, battery jars, or any glass vessel of sufficient size will do. Ordinarily the greatest difficulty is encountered in the equipment of the individual student. The following account of such apparatus as the student finds necessary for his work was published in the Journal of Applied Microscopy, and indicates what it has been found possible to get along with.

APPARATUS FOR THE INDIVIDUAL STUDENT. The question of a suitable equipment for large laboratory classes in elementary zoölogy is often a most serious and perplexing one. Not only is it difficult to find the pieces of apparatus already made, but even when purchasable the attendant expense makes them unavailable in many cases where large numbers are required. In nearly every laboratory these difficulties have been met and solved more or less satisfactorily, usually by designing such apparatus as can be made in local shops.

Such a set for the individual student, evolved in actual practical work, is described here. Aside from dissecting-pans and instruments, it consists of two pieces—one an easel, the other a standard for the support of lenses, etc. The easel is merely a piece of soft pine or poplar board $5 \times 6 \times \frac{1}{4}$ inches, supported behind by a piece of bent wire attached by small staples. Crude and simple as this is, it insures better work for the student at a much less degree of personal discomfort than is otherwise possible. Since the style of drawing usually required of beginners is that known as orthographic projection, it becomes necessary to view the specimen from directly above each part drawn. If no support is provided, the student either lays the specimen upon the table and endeavors to look down upon it, or he props it against books or other objects, so that it may be observed more easily. In either case the process is time-consuming and troublesome.

The specimen, a crawfish for example, is pinned to the board against a suitable shade of paper for a background, the appendages are arranged and secured to the board, which is then erected at such an angle that the line of sight falls upon it normal to the surface. In this position the animal is well lighted, is easily measured, and the tendency to introduce perspective in the drawing is minimized. When a lateral view is desired, the specimen is pinned to the top of the board near one side, the abdomen is flexed in a natural manner and fastened to the side, the appendages are brought down and secured, and the easel adjusted at the upper angle. It is not difficult to draw the animal when thus mounted, for a proper view is easily obtainable, and the edges of the board serve as guide-lines from which to measure.

The lens-support is made by taking a piece of brass rod three-sixteenths of an inch in diameter by ten inches in length, rounding one end with a file, and splitting the other in the center for an inch with a saw. Two holes are drilled through this end at right angles to the split, and

then, after heating, the halves are bent out until the flat surfaces lie in one plane. By means of rivets passing through the small holes the rod is secured in the middle of a tin ointment-box lid about three inches in diameter, which, in turn, is filled with melted lead. The standard thus produced is very firm and stable and occupies little room.

The lens-holder attaching the magnifier to the standard is made by taking suitable brass or galvanized-iron wire and forming on one end a loop of proper size to hold the lens, and on the other a close spiral of about four or five turns whose inner diameter is very slightly greater than that of the brass rod in the standard. Two of these are conveniently formed at one time by winding a spiral of eight or ten turns in the middle of a piece of wire twice the length of the desired support. This is then cut through the center and rings formed at the free ends for holding the lenses. It is advantageous to bend the support downwards, so that the lens may be lowered over the edge of the dissecting-pan. The lens thus supported may be swung around over a large specimen, and is conveniently focused by sliding the spiral up and down the brass rod.

This apparatus, by the addition of another lens-support, serves an excellent purpose in the examination of small parts and dissections, and makes the use of the microscope much easier for the beginner. In making use of the apparatus for this purpose, it is arranged as follows: Upon the ring of the lower support is placed a piece of non-drying modeling-clay (to be purchased of dealers in art and laboratory supplies). If the parts are to be examined dry, they are pressed down into the clay and arranged as desired; if they are to be immersed in water, a depression of suitable dimensions is made, and in the bottom the parts are secured. Water is now poured into the improvised pan and the specimen is ready for observation. Should specimens transfixed by pins be used, they are easily fixed and oriented in the clay. The holder is elevated to a convenient height above the table, the lens is focused, and the observer may then examine the specimen with one eye and, without moving the head, make the drawing.

The modeling-clay previously mentioned is useful in many ways. When irregular objects are to be held in position, either upon the table, easel, or wire support, they may quickly and easily be secured by a piece of the clay. Small fragile structures, such as the mouth-parts of insects, are readily mounted in any position by pressing them into the surface of the clay. Numerous other uses suggest themselves in practical work, which need not be mentioned here.

Aside from the two pieces of apparatus described, nothing more is required for class use except dissecting-pans and instruments. The former should be of different sizes, and may be made by pouring melted paraffin into suitable tin pans. It is usually desirable to have projections of some sort in the bottom to anchor the paraffin. For many purposes a black background is desirable, and this is obtained by mixing lampblack with the melted paraffin. Small pans may be made by using the bodies of the ointment boxes, the tops of which were utilized as the bases of the lens-standards. Small pasteboard boxes thoroughly soaked in melted paraffin are light and convenient and last well.

Improvised dissecting instruments, except needles, are not to be recommended. Excellent ones, perfectly adapted to their purposes, may be purchased at reasonable prices, and are always to be preferred.

OUTLINE OF THE COURSE. Every teacher has his own ways of working, and can secure the best results by following out the methods that seem to him best adapted to the time and place. Nevertheless, there are certain general principles that should govern the presentation of any subject, and in order to indicate the nature of these to such teachers as may be in doubt concerning the extent and character of the work involved in an elementary course in zoölogy, some suggestions may be given. In the first place, it must always be held clearly in mind that zoölogy is the study of animals and not of text-books. Evidently enough, then, the course must be so arranged as to give the student the largest personal

acquaintance with animal forms, and since it is obviously impossible to bring before him anything but a small representation of the animal kingdom, such a selection must be made as will give a place to all the important groups. In this matter of selecting the so-called "type specimens" there is a good deal of latitude, which may be improved by utilizing common indigenous forms, but the temptation to take what is at hand must not be allowed to exclude from consideration representatives of important groups that are not so immediately available.

In making this selection of types, then, the first consideration is representativeness. The form chosen for study must be one that exhibits clearly the peculiarities of structure which mark the group of which it is a member. In general only the salient morphological points can be brought out, but in one or two forms that are particularly favorable a more detailed study can be undertaken with profit. By this means the relative values of structural characters as a means for determining the relationships of animals can be demonstrated practically. The number of groups that can be studied will depend to some extent upon the availability of the material and upon the equipment with which it is to be so studied. In general, representatives of the following branches will be found adapted to the ordinary high school: Arthropoda, Mollusca, Echinodermata, Annulata, Cœlenterata, and Vertebrata. Because of their numerical importance and practical bearing upon human affairs the arthropods may demand a more extended consideration than the other types.

To meet the requirements of the course there may be selected the following animals for the laboratory work: Crawfish; grasshopper; clam; starfish; earthworm; jelly-fish; frog. Of this list, all except the starfish and jelly-fish may be found in practically any part of Kansas, so that, as a matter of convenience, they leave nothing to be desired. These forms represent their branches perhaps as well as individual species may, and are of convenient size to work with.

The order in which these forms are taken up is of no little importance, but it is scarcely possible to make a rule that is of general applicability. A strictly logical method of procedure would, of course, be to commence with the lowest forms and study the higher in the order of their complexity, or conversely, to note the highest development of morphological characters, and then to trace them back in the simpler animals. To most workers there have appeared practical objections to both plans. In the first instance the forms are small and require the use of a compound microscope, which places the beginning student at the double disadvantage of working with strange objects under quite unfamiliar conditions of observation. There is the further difficulty that an instalment of compound microscopes is necessary, and this is often beyond the resources of the high school. The main objection to the second plan is that it introduces the student to a highly complex development of the various systems, which not only renders necessary very skilful dissecting work, but occupies a disproportionate amount of time for attaining what is desired of the beginner. A compromise plan which is thought by many to obviate to a considerable extent the difficulties attaching to the others is to start the student out on a form of convenient size in which the various systems are well enough developed to show in a simple way the main features characterizing them. In this manner the principal structural features and relations of organism may be brought out in a somewhat diagrammatic way, and then by working down to the simpler forms the earlier stages of development may be seen and understood. Finally, with all this preparation, the vertebrate type may be studied and its complex structures appreciated. It is with this idea in mind that the arrangement of types previously suggested has been made.

The mere study of these few specimens, however, is not sufficient—such a course would be almost as bad as the use of a text-book alone. Two things are sought from the personal study of the type specimens by the student. In the first place, it trains his powers of observation

and comparison, and gives the instructor an opportunity to determine where the weak points in his preparation and work are. The other end sought is to give the student a concrete detailed image of one animal out of a representative group. With a definite conception thus established regarding the type specimen, it is possible to take up other members of the group and bring out the structural features of the various subgroups. As an example of how this part of the work may be carried on, the case of the grasshopper, the crawfish and the other arthropods may be instanced. If the crawfish has first been studied as the representative of the lowest arthropod class, then the grasshopper, representing the highest class, after having carefully been worked out as an independent organism, may be compared system by system with the crawfish. This will develop the main resemblances and differences in the arthropods, so that the student will know what characters differentiate this branch from others. Specimens of the Arachnida and Myriapoda may then be examined and the further class distinctions noted. It is not necessary for the student to dissect and draw all the forms; it is, in fact, much better for the instructor to take a few students aside and confront them with the specimens, asking them to tell wherein they resemble the forms already studied. If they have previously listened to a lecture upon the whole arthropod branch, or have read up in a good text upon the subject, they may be asked to classify the specimens into classes. When the main characters of the branch have thus been worked out by the student, attention may be turned to minor structural characters which serve to differentiate the subgroups.

To indicate how this part of the work may be presented, a series of comparisons based upon the grasshopper may be suggested. The grasshopper, from the order Orthoptera, may be compared with specimens of other insect orders, under the immediate supervision of the teacher, if possible, and these group characters brought out. When the students have acquired the ability to distinguish the insect orders, family characters in the Orthoptera may be illustrated by specimens of crickets, cockroaches, walking-sticks, etc. If it is thought desirable to go further, generic and specific characters may be pointed out in the type form studied. The general principle always to be followed is to proceed from the known ground established by a study of the type into the unfamiliar territory occupied by the nearly related forms. When one branch is thus disposed of, another is taken up in a similar manner, and after having been worked over is compared with the previously studied group, so as to establish broad relationships connecting the two. In this way the student is gradually led to a general conception of the animal kingdom, based upon his own individual experiences.

Along with this first-hand observation and correlation work, which should be embodied in a well-kept note-book, there should go careful readings and recitations upon the general laws and phenomena appearing in animals. The life-histories of a few forms should be studied personally and read about by the students, and some simple physiological experiments carried out. It is a good exercise to have certain topics assigned for investigation and require written reports upon them. Insects offer good opportunities for this kind of work, and such questions as the following may cause the student to make profitable direct observations upon the living animals: "What structures and markings upon grasshoppers shield them from attacks of enemies?" "Describe the methods of flight in four species of grasshoppers." "Observe the actions of two grasshoppers when they meet—do they appear to have any means of communication?" "Do different species of grasshoppers appear to inhabit particular localities?" "What parasites can you find in or upon the grasshopper?"

COLLECTION AND CARE OF MATERIAL. In most cases it is a comparatively easy matter to secure supplies of grasshoppers, crawfish, clams, earthworms, etc., and wherever it is possible to have the fresh material it will usually be best to use it. When it is not convenient to keep or to secure

specimens of this character, preserved material of the proper sort will serve most purposes. A rule that should almost invariably be observed is to secure material when it is plentiful, and not wait until it is needed. The cheapest and most convenient preservative is a solution of formaldehyde gas. This occurs in the market as a forty-per-cent. solution, called *formalin*, which is to be diluted to two per cent. or four per cent. A two-per-cent. solution is made by taking one part of formalin and nineteen parts of water; a four-per-cent. solution, by using one part of formalin and nine parts of water. Generally the specimens should go into the four-per-cent. solution for three or for days, and then be kept in the weaker mixture. Earthworms must be killed and preserved in alcohol. If running water is available, sufficient live crawfish, clams, etc., may be kept in aquaria, or even in its absence, by keeping aquatic plants with the animals they will thus secure enough oxygen. Earthworms may be kept in a tub of dirt, if it is moistened occasionally. Cages of screen wire may easily be improvised for keeping grasshoppers alive.

Experience has taught that one of the great difficulties in the way of the proper teaching of Zoölogy in the high school is the difficulty teachers have in securing material. In this, as in other matters, the University is desirous of assisting the other schools, and will endeavor to supply material at cost.

WHERE TO PURCHASE SUPPLIES. Microscopes and laboratory apparatus: Bausch & Lomb Optical Company, Rochester, N. Y.; Spencer Lens Company, Buffalo, N. Y. Marine specimens: Supply Department, Woods Hole Biological Laboratory, Woods Hole, Mass.; Henry M. Stevens, Carlisle, Iowa. Glassware, etc.: Whitall, Tatum & Co., Philadelphia, Pa.

PHYSIOLOGY. *One-half unit.*

Review elementary physiology and study chemical composition of the body, the histology of the tissue, physiological processes of digestion, absorption, respiration, metabolism, secretion, excretion, and nerve control of the organs of the body.

Use tables, outlines and diagrams freely. Give special attention to the spelling of the terms used in the subject.

Illustrate anatomy by dissection of frogs, rabbits or cats, or by specimens from the butcher-shop.

Study chemical composition of the tissues as far as possible by laboratory experiments. Show the amount of mineral and animal matter in bone, the presence of proteid, sugar, water and minerals in muscle. Show chemical and physical properties of alcohol, process of fermentation and distillation. A compound microscope is needed in histology and a skeleton and manikin are valuable aids in anatomy.

The following texts are suggested as covering the work of this course:
The Human Body, Briefer Course, Martin; Henry Holt & Co.
Physiology by the Laboratory Method, Brinckley; Ainsworth & Co.
Human Physiology, Thornton; Longmans, Green & Co.
Practical Physiology, Blaisdell; Ginn & Co.

Group VI.

HISTORY.

EUROPEAN HISTORY. *Three units.*

The entrance regulations of the University provide that two units of European history must be completed before the end of the Sophomore year. A unit is interpreted to mean one year of five hours a week in high school, or one term of five hours a week in the University. Credit is given only for work in English history; ancient history—*i. e.*, history of Greece and Rome; or medieval and modern European history—*i. e.*, the history of Europe since 475. One term's credit will be given to students presenting a year's work in the high school in any of these subjects. The department of European history offers three courses mentioned above in the Freshman and Sophomore years in the University, so that students who have not taken any or all of them during their high-school course have ample opportunity to do the work after entering the University. Students who receive credit at entrance for work done in the high school, however, cannot, of course, take the same work in the University for credit. Each of these courses, whether done in high school or University, must be complete in itself, and no entrance credit can be given for such courses done as part of the work in general history. It is expected, of course, that the high-school work in history will include as much outside reading, map-making and note-taking as possible.

CURRICULUM. The American Historical Association has recommended that four years be given to the study of history in high schools, whenever it is practicable to do so. When this can be done, the first year should be devoted to Greek and Roman history, with a preliminary study of the oriental nations; the second year, to medieval and modern European history; the third, to English history; and the fourth, to American history. Those schools which find it desirable to give only three years to history are recommended to place Greek and Roman history in the second year, English history in the third year, and American history in the fourth. When two years only can be given to history, either Greek and Roman or English history may be chosen, in which case the third year is recommended. If a separate course in medieval and modern European history is not given, English history should be treated with constant reference to European history. The department of European history in the University of Kansas hopes that those high schools which have a four-year course of study will, as far as possible, arrange their work in history according to the above plan, which has been elaborately discussed in the report of the Committee of Seven.

TEXT-BOOKS. Within recent years a serious effort has been made to prepare good text-books in history for secondary schools. The text which will be found most satisfactory depends largely upon the school in which it is to be used and the teacher who is to use it. It should not be forgotten that a text which is satisfactory for the first-year class in high school may be unsatisfactory for the third-year class. Each teacher must learn by experience the text which, under given circumstances, is best. In selecting a text for Greek and Roman history, the teacher will do well to examine those of Morey, West, Wulfson, and Myers. For medieval

and modern history there are also four very good texts, Robinson, Munro and Whitcomb, West, and Myers. Robinson and Myers begin with the Germanic invasion of the fifth century; Munro and Whitcomb and West begin with the empire of Charlemagne and devote much more space to the nineteenth century than to the earlier periods. There is even a greater number of books to choose from in English history. Coman and Kendall, Larned, Andrews, Wrong, Cheyney, Channing and Higginson or Montgomery may be recommended. All of the books mentioned are furnished with lists of topics and references which enable the student to supplement the text-book work with outside reading of a general or special nature.

CLASS RECITATIONS. The best text-book, the most fully equipped library, can nevertheless do but little toward insuring success in the teaching of history. Whatever success is achieved will depend ultimately upon the use which the teacher makes of the recitation hour. Aside from occasional written examinations, and supplementary oral or written reports, the recitation hour should mainly be devoted to developing the subject by means of questions and answers. Simple as it may seem to ask questions, this method, when properly used, requires ability of a high order and produces results which can be achieved in no other way. It is indispensable that the teacher should have sufficient knowledge of the subject to conduct the recitation without reference to the text-book or to notes of any kind. He should have clearly in mind the main topics that he desires to develop and the order in which he wishes to bring them up. Although it is necessary to ask many questions which require mere memorizing of the text, the teacher should always endeavor to so frame the questions that success in answering will depend upon the student's ability to see relations between events. The test of successful questioning consists in the ability of the teacher to lead the student to follow a train of thought based upon a given knowledge of facts, which, left to himself, he would never have followed out. It is hardly necessary to say that the teacher must himself be able to perceive more than lies on the surface, and he should carefully avoid what are known in the courts as "leading questions."

There are no rules for learning the art of successful questioning; success depends upon natural gifts and practical experience. Some very common mistakes, however, may be pointed out. Avoid questions on the one hand that can be answered by "yes" or "no"; on the other hand, generally avoid such as can be answered by memorizing the words of the text. Questions that require thought for an answer should be carefully distinguished from those that require guessing. The teacher must avoid a manner which leaves the impression upon the student that he is being quizzed for the mere purpose of showing up his stupidity or the teacher's cleverness. So far as possible, each question should be determined by the preceding question and the answer which has been given to it. Questions should be frequently asked in such a way that the only hope of a successful answer depends upon having given close attention to the entire recitation. Questions should be short, clear, and precisely worded; the experienced teacher knows by instinct when the student has not understood the question, and when he does not know the answer or seeks to gain time. In a word, such questions should be asked as will (*a*) require accuracy of knowledge, (*b*) test the ability to see relations, and (*c*) demand concentration of attention throughout the recitation.

SUMMARY. The department of European history thus desires of students who enter the University of Kansas that they shall at least have a good knowledge of the main facts of some particular period of European history, and, at best, a good knowledge of the main facts of the entire field; in either case, it desires that they shall have had, in addition, some practice in the use of books, and some training in perceiving fundamental historical relations.

GREEK AND ROMAN HISTORY.

Following the report of the Committee of Seven, Greek and Roman history falls in the first year of the high school. It should be remembered that the freshmen are not prepared to do the same kind of work as the juniors in English history. The value of Greek history particularly, and of Roman history in a less degree, for students of fourteen or fifteen, is that it is so rich in mythology and legend, and in the biographic side of history. This side of Greek and Roman history should be emphasized, for it is the side to which the student will be most attracted, and the student who does not learn the pagan mythology before fourteen will probably never learn it. The constitutional and economic aspects of Greek and Roman history are exceedingly difficult to grasp, and should be touched upon only incidentally. On the other hand, if the student is made to dwell upon the heroic figures of the pagan world, that would acquire for him a human interest and a reality which will never be lost. The periods of Greek history which should be emphasized for this purpose are the heroic age, the Persian wars, the period of Athenian expansion in the fifth century, the Peloponnesian war, and the Macedonian conquest. For Roman history, the early republic and the period of Mediterranean conquest will appeal to high-school freshmen more than the less obvious though equally important transformation of the empire. During the empire, the second century and the growth of Christianity in the third and fourth centuries are phases of the history of Rome that can be used effectively.

MEDIEVAL AND MODERN HISTORY.

Medieval history has a twofold value. The modern system of European states finds its origin in the middle ages, and to understand one's own civilization we must have some knowledge of the middle ages. The middle ages is the period that differs most from our own time in customs and beliefs and is better adapted than any other, therefore, to arouse in the student a live interest in history. The teacher should be on his guard against exaggerating the contrast, however, and thus leaving the impression that the people of the middle ages were strange, half-human beings; the differences in custom should be shown to arise from differences in conditions, not in people, and whenever possible the differences should be shown to be only superficial. For example, the student can be easily made to understand that heresy in the middle ages was nothing more than modern treason. Unfortunately, most of the text-books give but slight space to the period from 800 to 1648, going more fully into the period from 1648 to 1870. The wise teacher will rectify this by supplementary work in the library for the first period, while the latter period can be studied mainly from the text. The main points to be emphasized from the fourteenth to the seventeenth century are the changes in governments from the feudal type to the monarchial, the changes in religion and the international and domestic wars growing out of the religious quarrel, and the colonizing activity which grew out of the period of discoveries. In the eighteenth century the main feature is the international dynastic and territorial wars and their connection with colonial expansion and commercial interests. From 1789 to 1870, the overthrow of the old monarchies and the establishment of liberal governments are the points of central importance.

ENGLISH HISTORY.

In accordance with the recommendations of the Committee of Seven, the department recommends that English history be given in the third year of the high-school course. The students will have had by this time one or more years' work in history, and their minds will have been prepared to grasp the broader economic, social, and political principles with which this course should be primarily concerned. The aim throughout should be to give the students a clear idea of the origin and development

of those institutions, thoughts, manners and customs which form the basis of the modern civilization in the United States and Great Britain and her dependencies. While the student should have a quite definite knowledge of such persons as Alfred, William the Conqueror, Elizabeth, etc., the biographical side should be subordinated to the study of the people. His interest in these great men and women should be to determine just what influence they had upon the life of their time. Without dates and places, as has been well said, one is floating in time and space. A few cardinal dates, possibly a dozen, and the principal physical and geographical features of England should be carefully learned. Much time is often wasted in memorizing long lists of well-nigh meaningless dates and proper names, and in tracing out very superficially many military campaigns, but some attention may well be given to methods and principles of warfare. The student should be led to see that the customs of a people are not unlike, in many respects, the habits of individuals. He should endeavor to learn how our ancestors lived, what they thought and believed, and why. Frequent comparisons should be made between the past and the present. Knowledge of the English classics may be profitably used, as, for instance, the Canterbury Tales. The main outlines of the English constitution are clear and tangible, and care must be used not to run into difficult technicalities or to spend valuable time in considering merely the curious and irregular. Frequent comparisons with modern institutions should be employed. In the Anglo-Saxon period particular attention should be given to the development of local government and its connection with our own. In the Norman period the chief topics of interest are the manor, feudalism, and the growth of a strong central power. The fact that the manor was an economic and feudalism a political institution should be emphasized. A comparison between the French and English feudalism and a brief explanation of the reason for the differences may be undertaken. In the Angevin and Lancastrian periods special emphasis should be placed upon the rise of Parliament and the jury system with reference to our own jury and Congress. Attention should also be given to the gilds. Much attention should be given to the church as an institution. The abbott and the bishop should be regarded not merely as great church officials, but also as great feudal barons. The social and intellectual service of the monasteries cannot be neglected. The church during the middle ages was not merely a great religious organization, but did much of the work now done by the state. The Reformation should be viewed as a political and national as well as a religious movement. As the Reformation was a revolt against the civil authority and religious control of the church of the middle ages, so the Renaissance should be viewed as a revolt against the learning of the church, by which the methods of study were changed, and the revival of the Roman and Greek classics. In connection with the awakening of the fifteenth and sixteenth centuries, the influence of the discoveries and inventions should receive their due consideration. Neither the Reformation nor the Renaissance can be understood without frequent references to the corresponding German and Italian movements. A brief consideration of the spirit and aims of the great Elizabethan writers will be found valuable. During the Tudor period, point out that the Puritan movement was striving to purify the church of abuses by limiting the powers of the state in ecclesiastical matters. The Stuart period was one of readjustment between church and state, and between the crown endeavoring to extend the very great powers of the Tudors and Parliament claiming the right and privilege enjoyed under the Lancastrian kings. Both problems were solved in the fifty years following the revolution of 1689 by the establishment of religious toleration and formulation of the cabinet system with the preponderance of the house of commons. The chief topics of interest in the eighteenth and nineteenth centuries should be the growth of the British empire, the industrial revolution and the democratism of England since 1832. The student should be led to see that the influence of England is no longer confined to the British Isles

nor even to the United States; that many English institutions, such as parliamentary and party government, trial by jury, etc., have been and are still being adopted, with slight modification, by other nations of the world.

An excellent outline and copious bibliography, with specific references, may be found in "Outlines of English History," prepared by a committee of the New England Teachers' Association, Heath & Co., price 15 cents. A suggestive little pamphlet is "Outline for Review of English History," by Newton and Trent, American Book Company.

SCHOOL LIBRARIES.

Every school library should have at least one good historical atlas. Probably the most useful is that by Earle Dow (Holt & Co., $1.50), which has many maps and an index. Labberton's Historical Atlas (Silver, Burdett & Co., $1.25), Johnson's Historical Atlas (Scribner, $1), and Putzger's Historischer Schul-Atlas (German) (Velhagen and Klassig, 90 cents) are also good. Gardiner's Atlas of English History (Longmans, $1.50) is excellent, and of much service for general European history after the fifth century. Outline maps to be filled in by the student are almost indispensable. Several good and cheap series are published by McKinley Publishing Co., Philadelphia; Rand, McNally & Co., Chicago; D. C. Heath & Co., Boston; and Ginn & Co., Boston. Pictures are also very useful. The Perry Pictures (Malden, Mass.) and the Cosmos Pictures (296 Broadway, New York) offer cheap and desirable series. The Soule Photographic Co., Boston, also publish a series, somewhat more expensive. Of source material all libraries should have Robinson's Readings in European History (Ginn & Co., two volumes), Munro's Source Book of Roman History and Fling's Source Book in Greek History (Heath & Co.), either Colby or Lee's Source Book in English History, together with at least a few general books, of which a brief list follows:

Green, Short History of the English People.
Henderson, History of Germany.
Putnam's Stories of the Nations series will be found useful.
Adams, Growth of the French Nation.
Adams, Civilization in the Middle Ages.

Special periods.

Gibbon, Decline and Fall of the Roman Empire.
Motley, Rise of the Dutch Republic.
Bryce, The Holy Roman Empire.

Special topics.

Montague, English Constitutional History.
Adams and Stephens, Select Documents in English Constitutional History.
Jenks, Law and Politics in the Middle Ages.
Wilson, The State.
Fowler, The City State of the Greeks and Romans.
Seeley, Expansion of England.

Biography.

Plutarch's Lives.
Freeman, William the Conqueror.
Mrs. Green, Henry II.

Excellent series of biographies are the Heroes of the Nations, published by Putnams; Twelve English Statesmen (Macmillan); English Men of Action (Macmillan); Foreign Statesmen (Macmillan). It is impossible to indicate in full what should be in the high-school historical library. Some points should, however, be noted. The books should be simple and interesting. The teacher should read them first, if possible, before purchasing, to be sure they are fitted to his needs. Very large and expensive "sets," especially in extra bindings, should be avoided. A

good cyclopedia is useful, but one is enough and should not be relied on too much. Wall maps such as are published by Kiepert (G. E. Stechert & Co., New York, or Rand, McNally & Co., Chicago) are essential and may be bought one at a time if necessary. The department will always be glad to pass on lists of books submitted by the teachers who expect to buy books. Every teacher of history should own a copy of the Report of the Committee of Seven of the American Historical Association (Macmillan, 50 cents), and if possible the Report and Syllabus of the New England History Teachers' Association (Heath & Co., Boston). Book houses, like McClurg & Co., Chicago, or Bobbs-Merrill Co., Indianapolis, will be glad to submit prices and furnish books. In some cases this will prove the most convenient method for teachers and boards to order books.

AMERICAN HISTORY. *One unit.*

High schools in which the historical courses conform to the recommendation of the Committee of Seven of the American Historical Association will devote the last year to American history. For this course the University provides one unit of entrance credit, but in order to receive credit it must not be given earlier than the third year in the high school. If given earlier in the course, little more can be accomplished than has already been done in the grades. The plan of the American Historical Association contemplates uniting American history and civil government, but it will be found in practice that the work in history will consume the entire year and that instruction in civil government can only be incidental.

TEXT-BOOKS.

It will be best to base the work on some approved high-school text. A number of such books are available. Among them are Channing's Students' History; McLaughlin's American Nation; Adams and Trent's United States; Hart's Essentials in American History, and Montgomery's Students' History. Occasionally a specially trained instructor, provided with a good reference library, may successfully conduct the work without a text-book by the topical method. Courses given by this method must be approved by the High-school Visitor.

TOPICAL OUTLINES.

The use of a topical outline as a guide is recommended, even when a text-book is used. Several such outlines are to be had. An excellent one is by Mr. George R. Crissman, formerly superintendent of the Salina public schools. Others are one by the New England History Teachers' Association (Heath, 15 cents) and one published by the New York State Department of Education (Department of Education, Albany, 25 cents).

MAPS.

History cannot be taught advantageously without constant reference to maps. It is highly desirable that the student shall be familiar with the geography of the United States at the different stages of its development and shall be able to locate the places and physical features mentioned in his lessons. For a general map for the classroom there is probably none better than the large Land-office map. (United States Land-office, Department of Interior, $1.25.) No adequate atlas of American history is available. Numerous maps are to be found in the various text- and reference-books herein suggested.

A systematic series of outline maps, prepared by the department of American history of the University, and published by Ginn & Co., illustrates all the territorial changes that have ever taken place in the United States. Where it is impracticable to take time to fill out the whole series, the books may be divided and the maps used separately. These maps may also be used for other exercises in map work than those for which they are primarily intended.

REFERENCE-BOOKS.

Whether the text-book or topical method is employed, a reference library is necessary to the best results. In case any one of the suggested texts is used, the others may well be used for frequent reference. Good single volumes are:

American Politics (Holt, 80 cents).
Stanwood, History of the Presidency (Houghton, $1.50).
Lodge, Short History of the English Colonies in America (Harper, $3).
Fiske, Beginnings of New England (Houghton, $2).
Fiske, Dutch and Quaker Colonies, 2 vols. (Houghton, $4).
Fiske, Old Virginia, 2 vols. (Houghton, $4).
Fiske, American Revolution, 2 vols. (Houghton, $4).
Fiske, New France and New England (Houghton, $2).
Fiske, Critical Period (Houghton, $2).
Eggleston, Beginnings of a Nation (Appleton, $1.50).
Coman, Industrial History of the United States (Macmillan, $1.25).
Bogart, Economic History of the United States (Longmans, $2).
Dodge, Birdseye View of the Civil War (Houghton, $1.25).
Brigham, Geographic Influences in American History.
Hinsdale, Old Northwest (Silver, $1.75).
Hosmer, Louisiana Purchase (Appleton, $1).
Sparks, Expansion of the American People.
Earle, Child Life in Colonial Days (Macmillan, $2.50).
Earle, Customs in Old New England (Scribner, $1.25).
Earle, Home Life in Colonial Days (Macmillan, $2.50).
Drake, Making of New England (Scribner, $1.50).
Drake, Making of the Ohio Valley (Scribner, $1.50).
Drake, Making the Great West (Scribner, $1.50).
Thwaites, How George Rogers Clark Won the Northwest (McClurg, $1.20).
Thwaites, Rocky Mountain Exploration (Appleton, $1).

Among the series which are desirable may be mentioned: American History Series (Scribner, $1 each), including Fisher, Colonial Era; Sloan, French War and the Revolution; Walker, Making the Nation; Bingers, The Civil War and the Constitution; Bingers, Reconstruction and the Constitution. The Epochs of American History Series (Longmans, $1.25 each), including—Thwaites, The Colonies; Hart, Formation of the Union; Wilson, Division and Reunion; Rhodes, History of the United States Since 1800, 7 vols. (Macmillan, $17.50); Hildreth, History of the United States, 6 vols. (out of print, but may be obtained second hand); Schouler, History of the United States, 5 vols. (Dodd). In addition there is the very extensive series, Harts' American Nation, 27 vols., but which may be purchased separately (Harper, $2 each). The biographies of prominent Americans may be found in The American Statesman Series (Houghton, $1.25 each).

SOURCE MATERIALS.

A judicious use of source materials for illustrative purposes is recommended, though this phase of the work should not be carried to excess. Constitutional documents and laws should be used very sparingly. In this class the following may be found useful: Hart, American History Told by Contemporaries, 4 vols. (Macmillan, $2); Hill, Liberty Documents (Longmans, $2); MacDonald, Select Documents (abridged) (Macmillan, $2); Caldwell, Survey of American History (Ainsworth, $1.10). Books on the teaching of history: Bourne, Teaching of History and Civics (Longmans, $1.50); New England History Teachers' Association, Historical Sources in Schools (Macmillan, 60 cents); Whitcomb, Aids in Teaching History (Univ. of Cincinnati).

GENERAL SURVEY.

Believing that it will prove helpful to teachers, there is presented herewith a general survey of the topics which should be included in the

course, together with the per cent. of the total number of class exercises which may be devoted to each topic. This outline is taken from the Syllabus for Secondary Schools, published by the New York State Education Department.

GENERAL SURVEY OF THE FIELD.

The two outside columns show per cent. of total number of exercises.

7	I Discovery and explorations before 1607.	1 Land and resources 2 Discovery of America 3 Exploration and early settlement before Jamestown, 1492—1607	2 2 3
5	II Southern colonies, 1607—1760.	4 Virginia, 1607—1760, a typical Southern colony 5 Maryland, a typical proprietary colony 6 Carolinas and Georgia, the Southern frontier colonies,	3 1 1
10	III New England, 1620—1760.	7 Beginnings of colonization of New England 8 Early Massachusetts, a typical New England colony, 1629—'50 9 New England, 1636—1760, typical development of of American institutions	2 2 6
5	IV Middle colonies, 1609—1760.	10 Dutch and English in New York 11 Pennsylvania, "A Quaker Experiment in Government"; New Jersey and Delaware	2 3
6	V Colonies in the Eighteenth century to 1760.	12 Political and economic development, 1700—'50 13 Struggle between France and England for North America, 1689—1763 14 The colonies in 1760; political, social and economic conditions; comparisons	1 2 3
7	VI Union and Independence, 1760—'83.	15 Causes of the Revolution, 1760—'74 16 The Revolution, 1775—'83	3 4
7	VII Critical period, 1783—'89.	17 Confederation and Constitution	7
6	VIII Federalist supremacy, 1789—1801.	18 Organization of the government 19 Foreign relations, 1793—1800 20 Fall of the Federalists	2 2 2
5	IX Jeffersonian Republicans, 1801—'17.	21 Domestic policy of the Republicans 22 Expansion 23 Struggle for neutral rights	1 1 3
10	X Reorganization, 1817—'29.	24 Economic reorganization 25 Westward migration and internal improvements 26 Slavery and the Missouri compromise 27 Monroe doctrine and Panama congress 28 Political reorganization and triumph of Jackson	2 2 2 1 3
6	XI National democracy, 1829—'44.	29 Nullification in South Carolina 30 Overthrow of the United States Bank; financial questions 31 Antislavery agitation, 1831—'38	2 2 2
	XII Slavery in the territories, 1844—'60.	32 Annexation of Texas and the Mexican war 33 Struggle over slavery in the territories	
	XIII Secession and the civil war, 1860—'65.	34 Secession of the Southern states 35 The civil war, 1861—'65	
	XIV Problems of peace.	36 Reconstruction. The new South and the race problem 37 Political problems: Civil service, foreign relations, municipal government 38 Economic problems: Currency, tariff, trusts, labor, transportation 39 Summary and review of American history	

ECONOMICS. *One unit.*

THE PURPOSE OF THE STUDY OF ECONOMICS. With this, as with other subjects of study, two aims are to be considered: first, the development of mental faculties; second, the acquiring of knowledge concerning a field in which the student is to be engaged after leaving his studies. The first of these aims is generally spoken of as the educational, the second as the practical result of a study. Economics, as the science which classifies and explains the activities of man in producing and using wealth—activities that consume an extremely large portion of every man's life—may fairly claim to possess practical value to a very great extent. Nor is this study lacking in value for mental discipline. Teachers are now agreed that educational value is found, not necessarily in the subject, but rather in the way the subject is taught. Subjects that have been longer taught may have some educational advantage in the fact that their scope and method have been more clearly defined and settled by longer experience of teaching. Still, the disadvantage under which economics labors by reason of its comparative newness in the school is by no means great. Indeed, in the hands of a resourceful teacher this newness may add to the interest and usefulness of the study by making it more adaptable to peculiar conditions.

The second of the aims of study mentioned above—the accumulation of knowledge concerning things with which the student is to have necessary and important relations—can certainly be satisfied by few subjects so well as by the subject of economics. This practical value of economics as a high-school study, as a means of fitting for capable participation both in public affairs and in private business, has been set forth in a bulletin of the University (vol. VIII, No. 1), which will be sent on application to the registrar.

THE METHOD OF INSTRUCTION. The comparative newness of this subject and its consequent flexibility give opportunity for a good teacher to make economics extremely instructive by adapting his method to the conditions familiar to his students. It is generally found advantageous to arouse the elementary pupil's attention and interest by introducing the subject in a more concrete way than by dealing first and solely with the broad abstract principles of the science. If the student can be brought, in even a few instances, to appreciate the fact that these abstract principles are generalizations based upon and explaining familiar occurrences and problems of economic life, he will be made more willing to deal with the sometimes dry and unattractive, but inexorable, economic laws. Consequently the more recent text-books generally approach the real body of economic theory through introductory matter of some one of the following forms: (1) By a summary sketch of the main steps through which the familiar present economic organization has developed from the simple economic life of primitive man (*e. g.*, Blackmar's Economics, Ely's Outlines of Economics); (2) by a brief sketch of the economic history of the last century or two, thus showing more concretely than in the preceding, but for a briefer period, the evolution of existing economic conditions (*e. g.*, Seager's Introduction to Economics, Bullock's Introduction to Economics, Thurston's Economics and Industrial History); (3) by a sketch of the scope and method of economic science, or of the fundamental concepts and forces of economic life, or of the development of economic thought, sometimes in connection with economic history (*e. g.*, Newcomb's Principles of Political Economy, Seligman's Principles of Economics, Blackmar's Economics, Devine's Economics, Davenport's Outlines of Economic Theory; (4) by raising problems that have puzzled the pupil, or by calling upon him to explain facts so familiar as to have been overlooked. Some of the text-books use a combination of two or more of the above forms of introductory material. Each of these forms of stimulating the pupil's attention and effort may be used to advantage, but probably the third is least promising for elementary stu-

dents. The fourth may often be very helpful for this grade of students, but the teacher will be obliged to work out such a form to fit the environment and conditions of his own classes. He may find helpful suggestions, however, in Clow's Introduction to the Study of Commerce (Silver, Burdett & Co., $1.25); and perhaps also in Taylor's Economics of Agriculture (The Macmillan Company, $1.25), or in Fairchild's Agricultural Economics.

THE TEACHER. The method, however, will be of slight importance as compared with the teacher. A thoroughly good teacher will succeed with any method. The method can be no more than an aid to the teacher. First of all, the teacher must have an interest in the subject and a knowledge of it. "It should be taught by some one who knows a great deal more about the subject than he could possibly tell to his students." A teacher must have a knowledge exceeding the limits of the class text. The related fields of history and political science furnish much to better equip the teacher of economics, but especially important to him are a knowledge of economic history, especially of England and the United States, and of the history of economic thought. Only those who are familiar with these subjects can fully appreciate the frequency with which greater force and clearness are given to an economic principle by an historical instance in which its operation has clearly appeared. None but those who have some acquaintance with the development of economic thought can understand how important it is toward fully understanding and explaining economic principles as held at present.

EQUIPMENT. Works of reference for collateral reading are of great importance for both teacher and pupil. As the school and public libraries are generally deficient, especially in this important subject, it is desirable that extra effort be made to provide at least a few of the best works on economics. Care should be exercised in choosing these in order that not only the older writers may be represented, but also the numerous recent writers who give newer forms of expression to the old theories. Preference should be given, in getting together a school library, rather to more extensive and thorough works than to other brief works similar to the text-book, in order that the inquiring student may find in the library fuller and more satisfying information instead of merely a restatement of what the text has given him. Other works than treatises on economics should be at hand. Many governmental publications are very useful in this field. The books needed will differ somewhat according to the way in which the teacher treats the subject. Many of the treatises give bibliographies. One of the best recent lists of references may be found in Seligman's Principles of Economics (Longmans, Green & Co., New York, $2.25). The University will gladly advise teachers in this matter, if requested.

THE COURSE. After an introductory portion of one sort or another, as suggested above, chosen by the teacher to suit his interests and abilities and those of his pupils, the subject may be divided into the following main portions. Their order is subject to some degree of variation, different writers and teachers differing slightly as to the preferred order of treatment. In an elementary course it seems desirable to give very brief consideration to some portions of the subject, and to concentrate attention on some of the more pressing or more familiar portions, not only as a means of stimulating the pupil's interest, but also for the purpose of training him to close consecutive thinking on economic topics.

1.—*Consumption.* In the complete outline presented below, consumption is the first topic, although many teachers prefer to begin with production, as was, indeed, the earlier teaching practice of the writer. Man puts forth his efforts in order that he may in some way procure things to satisfy his desires for food, clothing, recreation, and many other sorts of wants. Hence, consumption, the process of obtaining such satisfaction,

seems the fundamental consideration—the motive of all economic action. Human wants, their variety, their constant development and extension, their significance as indices of civilization, furnish a familiar, although little considered point of entrance for the pupil. From the classification of these wants those of distinctly economic character are brought forth as the basis of this study. A clear presentation of just what economic consumption is and what it should be brings up the numerous problems of saving, luxury, waste, and the proper relation of consumption and production. Understanding the aim or motive, the pupil is prepared to go on to the consideration of the means by which the consumption is made possible, viz., production.

2.—*Value.* But before taking up production, the teacher may choose to briefly consider the fundamental principles of value. The reasons for this are: First, that value, according to the now universally accepted marginal utility theory, is the outcome primarily of human economic wants, and so can most clearly be treated in close connection with those wants; second, that the principles of value are so frequently referred to throughout the study of economics as to make the postponement of their elucidation extremely inconvenient to both teacher and pupil. A more exhaustive consideration of value may be taken up later, if desired.

3.—*Production.* The true nature of production and its difference from mere acquisition furnish a ready means of emphasizing the general social point of view, a most important step toward the betterment of many present abuses, and toward the growth of a better spirit of citizenship. The part played in production by land or nature, by labor or man, by capital, and by management, a special form of labor, as well as by other forces, such as social and political organization, should be clearly brought out, in order that the future citizen and business man may correctly appreciate the importance of each and of right relations between them. A study of the various main forms or classes of production, with the differing importance of the factors in each, will greatly help the pupil toward broader and fairer views than those likely to arise from his associations and individual interests.

4.—*Distribution.* This, the most complicated and difficult of the divisions of economics, will probably have to be treated briefly and incompletely in the high-school course, but the teacher may at least make sure that the problems are clearly presented to the pupil's mind if not entirely solved. That the present problems of distribution are more than mere matters of exchange and transportation should be clearly grasped by the teacher and as clearly impressed upon his pupils. Consequently the questions of rent, wages, interest and profits must be carefully discussed, if not fully disposed of. Attention may also be profitably called to the great influence of social law, custom, and organization in this field. Exchange, with its various organizations, forms and methods—transportation in its present and growing importance, the mechanisms of trade, money and credit, the important institutions of banking, domestic and foreign trade—all offer material for profitable study. In beginning the consideration of exchange some teachers find it advisable to give fuller consideration to the principles of value, but this seems of doubtful advisability in the high school.

Many problems of general or local interest, such as irrigation, improved roads, agricultural methods, the tariff, various other taxes, the economic functions of various grades of government, labor organizations, monopolies, socialism, and numerous others, will present themselves from time to time. They should not be permitted to absorb attention to the exclusion of the principles upon which right judgments concerning them must be based, nor should they be hastily or unwisely excluded from consideration. The teacher's judgment will find abundant exercise in determining the attention due them. Such subjects may generally be treated most satisfactorily in connection with that portion of the course

to which they are most intimately related, and indeed they are likely to present themselves in such connection.

Every teacher should have at his command a few books that treat the subjects more fully than are found in the works named above, but which are too difficult to be used as text-books. The following carefully selected books will answer the purpose:

Industrial Evolution, by Carl Bücher.
Evolution of Industrial Society, by Richard T. Ely.
The Races of Man, by J. Deniker.
The Industrial and Social History of England, by Edward P. Cheyney.
The Principles of Economics, by E. R. A. Seligman.
The Principles of Economics, by Frank A. Fetter.
Money and Banking, by William A. Scott.
The Labor Movement in America, by Richard T. Ely.
The Trust Problem, by J. W. Jenks.
Taxation in Modern States and Cities, by R. T. Ely.
Economics (for colleges), by F. W. Blackmar.

CIVICS. *One-half unit.*

Government in general.
- Necessity.
- Origin.
- Forms.
  - Home; school; township; county; city; state; national.
- Kinds of national.
  - Monarchy; aristocracy; democracy; republic; mixed.

Rights and duties of subjects of government.
- Rights: Protection; liberty; property; education; suffrage—ballot, Australian ballot.
- Duties: In the home, community, state, nation.

Laws to guarantee rights.
- Common and statutory.
- Civil and criminal.

Means of enforcing rights and of exacting performance of duties.
- Police power; courts—juvenile and ordinary; jails and penitentiaries.

United States constitution.
- Origin.
  - Colonial government.
    - Charter; proprietary; royal.
  - Colonial congresses.
  - Articles of confederation.
  - Federal conventions.
    - Members; compromises.
  - Adoption of constitution.

Constitution.
- Definitions.
  - Constitution, nation, state, sovereignty, right, privilege, immunity.
- Mechanical construction.
  - Articles, sections, clauses.
- Departments.
  - Legislative.
    - House of representatives—organization; members; election; qualifications; apportionment; gerrymandering; contests; vacancies; judicial powers; privileges; compensation; representatives from territories.
    - Senate—organization; members; election; term; qualifications; contests; vacancies; officers; judicial power; executive powers; privileges; compensation.
    - Method of legislation—meetings of Congress; adjournment; sessions; quorum; committees; calendar; process of passing a bill; veto; voting; "lobbying"; "filibustering."

Constitution—*continued.*
Departments.
Legislative.
Powers of Congress—kinds. Taxation—kinds, tariff, excise, commerce. Finance—money; debt; banks; bankruptcy; counterfeiting. Postal. Copyrights and patents. Courts. War. Army. Navy. Militia. Exclusive legislation. Territories—acquisition, government.
Powers denied Congress—Importations prior to 1808. Writ of *habeas corpus*. Bill of attainder, *ex post facto* law. Capitation tax. Export duty. Equality of ports. Money drawn from treasury.
Powers denied the states—absolute prohibitions—treaty; alliance; confederation; marque; money; bills of credit; legal tender; attainder; *ex post facto* law; contracts; titles; import and export duties. Conditional prohibitions—tonnage; troops; warships; compacts; war.
Executive.
The President—term, qualifications. Election; party organization. Compensation. Vacancy. Succession laws. Impeachment.
The cabinet: Departments; duties; bureaus.
Powers: Diplomatic—treaties, foreign representatives. Legislative—special sessions, adjournment, veto, message, execution of laws. Military—commander-in-chief, war officers. Judicial—pardons and reprieves. Civil—appointments and removals.
Judiciary—composition; tenure; compensation. Courts—supreme, circuit court of appeals, circuit, district, territorial, claims, District of Columbia, equity, diplomatic, colonial. Judges—jurisdiction of each court. Kinds of jurisdiction. Treason—definition; punishment.
Interstate relations, public acts, records, etc. Privileges and immunities; fugitives from justice; fugitives from service.
Relations between states and nation: Admission of states—method; limitations; territorial government; control of dependencies. Guaranties of the United States to every state.
Amending the constitution—how? Limitations.
National debts; supreme law; oath; religious test; ratification.
Amendments.
The bill of rights: Guaranties to the people—freedom, speech, press, religion, assemble; bear arms; security in homes. Quartering troops; accusation of crime—presentment or indictment, trial, bail, fines, punishment.
Later amendments—suits against a state; election of President. Slavery, abolished. Citizenship, suffrage.

State constitution (if not provided for elsewhere in course of study).
Origin.
Bill of rights.
Departments.
Other articles.
Amendments.

Group VII.

ARITHMETIC. *One-half unit.*

The object of one half-year of arithmetic in the high-school normal course is not only to develop a practical degree of accuracy and rapidity in the fundamental rules and the various processes of arithmetic, but to secure an approach to the subject with the developed reasoning power of the high-school pupil so as to enable him to see the application of principles to practice. Emphasis should therefore be given to the best methods of presentation, good forms of analysis, neatness and good arrangement of work. Drill should include practical rules for weighing, measuring, estimating; common business forms, notes, accounts; the application of the principles of percentage, drafts, banking; ratio and proportion and their applications, including drill on shortening ordinary processes by the use of proportion; involution and evolution, considered with reference both to their algebraic and geometric relations. The course should be, in brief, a comprehensive and thorough review of the subject, with a view to clear understanding of principles and accuracy in practice.

COMMERCIAL.

GENERAL SCOPE. The application of general education to vocational life is the ultimate object of instruction in commercial subjects. The mere routine of office work has little to do with a broad commercial knowledge. Every member of society needs an understanding of the primary requirements of business. The high school needs to be brought into closer relation with the problems of life, and when this is accomplished the number attending will be much larger. In his study of the commercial subjects the student should be trained for life as well as for livelihood. It is hoped that the commercial course may increase the student's efficiency in whatever vocation he may choose, by enabling him to understand more clearly his relations to his fellow men; by introducing him to the methods and usages of modern business life; by leading him to see in transactions around him something of the great world of commerce; by giving him a slight knowledge of those laws which will be of most benefit in the ordinary affairs of life; by making him a more intelligent citizen through the thoughtful, systematic, careful training of his powers, and by helping him to be a thinking individual, not an automaton.

BOOKKEEPING AND BUSINESS PRACTICE. *One unit.*

The work in bookkeeping and business practice should use matter approaching as nearly as possible real transactions. The student should be led by induction to master the principles of the subject, and should learn to think in terms of the account. He should receive drill in double-entry bookkeeping, working a large number of graded sets from day-book or journal entry to the closing of the ledger; should become familiar with business paper of the more common forms, such as bills, receipts, notes and drafts; should learn how to make deposits and draw checks. When double entry is completed, the principles of single entry are taken. Something should be learned of wholesale and retail business, making use of special-column books. Shipping and commission business should be introduced through sets taken from actual transactions. The elemental principles of banking in relation to business life should be

studied, beginning with the simplest transactions. All sets used should be of sufficient length to show the continuity of business, and fragmentary work should be avoided. The best modern business methods are to be used. The fundamental principles of modern business should be studied, and the tracing of transactions from their beginning to their end should receive attention. The student should be helped to decide how, in actual life, he could best serve the business interests concerned; and should become an independent thinker. The object of the course is to fit the student as fully as possible, without actual contact with business affairs, to enter practical business life.

COMMERCIAL LAW. *One-half unit.*

The aim of instruction in commercial law is to familiarize the student with his individual rights, duties and limitations in the business world. It involves an understanding of those fundamental legal principles most often of value to a business man. Law is in the main only common justice and common morality, and this fact should be emphasized throughout the entire course. There is no other subject which so clearly brings out the individual's relation to the community, the state or the nation. The student should understand the great divisions of law, and should be given a working knowledge of the laws governing contracts, personal and real property and bailments, agency, partnership, corporations, insurance, negotiable and other commercial paper, collections, common carriers, courts and their jurisdictions, pleadings and practice. In connection with commercial paper, deeds, mortgages, etc., standard forms should be available for illustration, and the student should be required to draw up the more common forms in concrete transactions.

COMMERCIAL GEOGRAPHY. *One-half unit.*

Commercial geography involves two points of view—physical geography, and the activities and organizations of men. The balance between economic affairs and physical science should be made the basis in the presentation of this subject. The interpretation of commercial life as dependent upon physical surroundings is the object of the study. The facts of commerce are treated as the effect of conditions that determine the quality and quantity of trade. Geography is the primary consideration; commercial data are of little value unless they are so arranged as to illustrate the great principle of cause and effect. The great trunk lines of commerce should be traced from their sources, and their causes analyzed. Maps must be freely used in determining the physical features of a country. Invention, governmental activity or conservatism, industrial processes and products, transportation facilities, kind and extent of manufactures, influence of other resources of the territory, are some of the economic questions to be considered. Only principal commodities should be studied, and statistics should be used with moderation. A geographical museum of countries and products is of great value, and is easily started. With skilful handling this subject becomes of absorbing interest, and from it arise conceptions of world-activity more broadening than can be found in any other subject in the course.

STENOGRAPHY. *One unit.*

Shorthand requires precision in distinguishing sounds, and necessitates the closest attention. Accuracy in reading and in making forms must be insisted upon from the beginning. The student should be given a general view of the system, being drilled thoroughly on each principle as it is presented. Logograms, contractions and phrasing should receive special attention. No carelessness whatever should be allowed. In transcription, the spelling, paragraphing and general arrangement must be absolutely correct. Accuracy is the first requirement in shorthand, speed the second. In the latter half of the year miscellaneous dictation

work should be introduced, thus adding to the student's vocabulary and increasing his general knowledge. Common legal and business forms may well be included in the dictation. Verbatim reporting of speeches, sermons, etc., and transcription of the same, furnish valuable practice. Much reading of shorthand should be required. Standard selections in shorthand may be secured at reasonable cost, and the more of these the student can read the better for his shorthand work. The ability to transcribe accurately work taken at the rate of 100 words per minute should be the minimum requirement in this course.

TYPEWRITING. *One-half unit.*

Introduce the subject with a careful study of the machine to be used, with instruction as to its care, mechanism and possibilities. The touch system of writing should be used exclusively. Proper fingering should be insisted upon in all manipulations of the machine. A light, rapid, smooth and even touch must be acquired early. After the keyboard is mastered accuracy should be the first object to be attained. Neatness should characterize all work done. Voice dictation should be given from the beginning for a short period each day. The matter given should include letters, specifications, legal forms, selections from standard literature, envelope addresses, arrangement of business letters, and tabulations. Instruction should include writing on paper of different sizes with or without lines, taking manuscript poorly arranged or badly written, and transforming it into a correctly spelled and written copy. Style of arrangement is an infallible test of proficiency in typewriting, and should therefore be emphasized. To be able to write without error, and at the same time smoothly and rapidly, any kind of miscellaneous matter or business documents, is the end and aim of typewriting. The ability to write thirty-five words per minute in accordance with the above standard should be the minimum requirement in this course.

BUSINESS ARITHMETIC. *One-half unit.*

To make the student's work accurate, rapid and self-reliant should be the aim. More stress should be laid upon understanding of principles and processes than upon rapidity. The course should include practical short methods, continual mental drill, and much work in the fundamental operations. The method should be inductive, leading to a mastery of principles through problems. The student should be led to think accurately and rapidly, and mental development should be pronounced. When the principles are thoroughly mastered, the pupil will be independent of rules, and can easily solve the problems of ordinary business life. All processes used in common business transactions should be carefully studied. Only concrete and practical problems should be given, and the best modern methods used in their solution.

Group VIII.

DOMESTIC SCIENCE.

In preparing an outline for the teaching of cooking in the high schools of Kansas, it seems desirable to state that no entirely satisfactory textbook has been prepared upon the subject. Much must depend upon the individual teacher, and the instruction necessarily will be largely by lectures, supplemented more or less by reference done by the student.

It is desirable to have periods of ninety minutes each on alternate days, rather than a shorter period every day. Theory and practice so intermingle in the teaching of cooking that it is difficult to separate them advantageously. There is a certain amount of time lost at the beginning and end of each period by fire-building, utensil-cleansing, and the donning and removing of aprons, etc. The proportionate loss of time is much less when there is a ninety-minute period allotted.

The first object to be sought in teaching cooking is to inculcate in the minds of students a love for and an appreciation of household duties. In every instance the reasons for processes should be carefully explained, for work ceases to be drudgery when it is understandingly performed. Habits of personal cleanliness, cleanliness of methods, and obedience to instruction should be insisted upon.

In all cases the teaching will be more satisfactory if it can be assumed that the student has some knowledge of chemistry, though this knowledge is not absolutely essential. The state text on physiology will be found to prepare for a part of the work given in cooking.

It is necessary that the instructor should have received some training in management of laboratories before attempting to teach this branch.

The amount of equipment required may prove expensive for the weaker schools. In all cases there should be individual desks for each student, supplied with a drawer, bread board and desk board to be used on the desk during working period. The drawers should be equipped with the articles most often used by the student. The top of the desk must be of some material that can be thoroughly cleansed. When wood is used as the top it should be well seasoned, close grained, and of a variety that will warp but little when frequently wet. Wherever possible there should be a separate stove for each worker. One or more sinks supplied with hot and cold water are necessary, as is one range for wood, coal or gas. The ideal arrangement of desks and sinks is one sink for every two or four students, placed between the pairs of desks, the whole being arranged in the form of a hollow square, open at least at two ends. Inexpensive kitchen tables or kitchen cabinets may be used as desks when rigid economy is necessary.

Lesson I.
- Enrolment of class.
- Assignment to desks.
- Dictation of laboratory rules.
- Explanation of laboratory in general.

Lesson II.
- Cleansing agents.
  - Water—hard and soft.
  - Soap.
  - Scouring materials.

Lesson II—*continued.*
- Cooking utensils.
  - Sanitary.
    - Non-corrodible.
    - Easily cleaned.
    - Light weight.
  - Durable.
  - Economical.
  - Æsthetic.
- Laboratory accompanying this lesson should be that of cleaning desk and general utensils.

Lesson III.
- Objects of cooking.
- Methods of cookery.
- Definition of food.
- Classification of food.

Lesson IV.
- Water as a food.
  - Sources.
  - Contamination.
  - Purification.
  - Quantity required.
  - Physical changes from heat and cold.
- Laboratory.
  - Heating of water, observation of temperature at which steam forms, gathering of air bubbles on sides of utensil, the formation of steam globules on bottom of utensil, point of active ebullition. The change of boiling-point due to density of solution may be illustrated by the addition of sugar to the boiling water. The sugar solution should be boiled until all water is driven off and until the resulting sugar becomes an amber liquid. This may be flavored with hoarhound, when it becomes hoarhound candy.

Lesson V.
- Carbohydrates.
  - Sugar. (See note below.)
    - Chemical composition.
    - Occurrence.
    - Manufacture.
    - Changes due to heat.
- Laboratory.
  - Peanut brittle.

Lesson VI.
- Carbohydrates continued.
  - Sugar.
    - Chemical changes.
    - Hydrolysis.
    - Digestion.
    - Dietetic value.
- Laboratory.
  - The making of fondant.

Lesson VII.
- Carbohydrates.
  - Starch.
    - Chemical composition.
    - Occurrence.
    - Manufacture.
    - Action in hot and cold water.
- Laboratory.
  - Experiments with starch.

Lesson VIII.
- Carbohydrates.
  - Starch.
    - Digestion.
  - Potatoes.
    - Composition.
    - Cookery.
- Laboratory.
  - Potatoes.
    - Boiled.
    - Baked.
    - Riced.

Lesson IX.
- Carbohydrates.
  - Starch.
    - Digestion completed.
    - Previous work reviewed.
- Laboratory.
  - White sauce—first method.
  - Creamed potatoes.

Lesson X.
- Carbohydrates.
  - Cellulose.
    - Structure.
    - Composition.
    - Occurrence.
- Laboratory.
  - White sauce—second method.
  - Creamed turnips.

Lesson XI.
- Carbohydrates.
  - Cellulose.
    - Digestion.
  - General rules for cookery of vegetables.
- Laboratory.
  - White sauce—third method.
  - Buttered crumbs.
  - Scalloped cabbage.

Lesson XII.
- Carbohydrates.
  - Cocoa and chocolate.
    - Source.
    - Manufacture.
    - Chemical composition.
    - Dietetic value.
- Laboratory.
  - Chocolate corn-starch mold.
  - Cocoa.

Note.—Sugar work is chosen because the student must understand sugar and sugar digestion before she can understand starch digestion. The quantities used may be very small, and if economy is necessary the products of the experiment may be sold.

Lesson XIII.
- Carbohydrates.
  - Cereals.
    - Definition.
    - Manner of growth.
    - Structure of corn, wheat and oats.
    - Rules for cooking cereals.
- Laboratory.
  - Cream of wheat with figs.

Lesson XIV.
- Carbohydrates.
  - Cereals.
    - Commercial preparation of cereal breakfast foods.
    - Dietetic value.
    - Economic value.
- Laboratory.
  - Cracked wheat.
  - Rolled oats.

Lesson XV.
- Vegetable acids.
- Mineral matter.
- Laboratory.
  - White sauce—first method.
  - Tomato soup.

Lesson XVI.
- General review of carbohydrate foods.
- Laboratory.
  - Escalloped macaroni.

Lesson XVII.
- Fats and oils.
  - Sources.
  - Chemical composition.
  - Changes due to heat.
  - Changes due to bacterial action.
- Laboratory.
  - Apple pie.

Lesson XVIII.
- Fats and oils.
  - Action of alkalies.
  - Digestion.
  - Dietetic value.
- Laboratory.
  - Soap-making.

Lesson XIX.
- Fats and oils.
  - Emulsification of fats.
  - Digestion completed.
- Laboratory.
  - Mayonnaise dressing.
  - Celery salad.

Lesson XX.
- Fats and oils.
  - Adulterations.
  - Substitutions.
  - Rules for frying in deep fat.
  - Definition of saute.
- Laboratory.
  - Rice croquettes.

Lesson XXI.
- Proteids.
  - General composition.
  - Occurrence.
  - Characteristics of albumens.
    - In water.
    - In saline solutions.
    - In acid.
    - In alkalies.
    - In alcohol.
    - When heated.
- Laboratory.
  - Experiments with white of egg.

Lesson XXII.
- Proteids.
  - Characteristics of globulins.
    - In water.
    - In saline solutions.
    - In acid.
    - In alkalies.
    - In alcohol.
    - When heated.
- Laboratory.
  - Soft-cooked egg.
  - Poached egg on toast.

Lesson XXIII.
- Proteids.
  - Eggs.
    - Sources.
    - Structure.
    - Preservation.
    - Tests for condition.
    - Dietetic value.
- Laboratory.
  - Omelets.

Lesson XXIV.
- Proteids.
  - Milk.
    - General composition.
    - Sources.
  - Digestion of proteids.
- Laboratory.
  - Junket custard.

Lesson XXV.
- Proteids.
  - Milk.
    - Changes due to bacteria.
    - Preservation and care of milk.
    - Dietetic value.
    - Digestion of proteids continued.
- Laboratory.
  - Soft steamed custard.

Lesson XXVI.
- Proteids.
  - Milk products—cheese.
    - Composition.
    - Manufacture.
    - Dietetic value.
- Laboratory.
  - Cheese pudding.
  - Baked custard.

Lesson XXVII.
- Proteids.
  - Meat.
    - General composition.
    - Muscle structure.
    - Effect of heat.
- Laboratory.
  - Pan-broiled steak.
  - Pot roast.

Lesson XXVIII.
- Proteids.
  - Fish.
    - Varieties.
    - Composition.
    - Dietetic value.
- Laboratory.
  - Fish fried in deep fat.

Lesson XXIX.
- Gelatin.
  - Source.
  - Characteristics in hot and cold water.
  - Dietetic value.
- Laboratory.
  - Lemon jelly.
  - Orange sponge.

Lesson XXX.
- Leavening agents.
  - Objects of leavening.
  - Rules for batters and doughs.
  - Use of air as leavening agent.
- Laboratory.
  - Popovers.

Lesson XXXI.
- Leavening agents.
  - Soda.
    - Manufacture.
    - Action with acid.
- Laboratory.
  - Gingerbread.

Lessons XXXII.
- Leavening agents.
  - Baking powders.
    - General composition.
      - Tartaric.
      - Phosphate.
      - Alum.
    - Residues left in bread.
- Laboratory.
  - Baking-powder biscuit.

Lesson XXXIII.
- Leavening agents.
  - Yeast.
    - Definition.
    - Mode of growth.
    - Requisites for growth.
    - Injurious micro-organisms.
- Laboratory.
  - Liquid-yeast making.

Lesson XXXIV.
- Flour.
  - Varieties.
  - Manufacture.
  - Qualities.
  - General composition.
- Laboratory.
  - Experiments washing out the starch and gluten of flour.

Lesson XXXV.
- Bread.
  - General composition.
  - Qualities of good bread.
  - Common faults of bread, with causes.
  - Dietetic value.
  - Economic value.
- Laboratory.
  - Bread-making.

The foregoing lessons are only offered as a suggestion, and can be extended by each teacher to meet the particular conditions under which she works. The more complete the equipment, the more rapidly can she progress in her work. It is never desirable to so overcrowd the student that she neglects cleanliness and order in her work.

MANUAL TRAINING.

OBJECT. The purpose of this course is to give a broader knowledge of materials and a wider range of expression. The united action of mind and hand secures coördination of mental and motor activities and by continued reaction insures the harmonious development of both mind and body. It gives to the pupil greater control of his physical powers and increases his ability to do his will by teaching him to know his possibilities and his limitations.

COURSE. To accomplish these purposes the work suggested for one year in the high school may be outlined as follows: For the first half-term it would be advisable to require the pupils to take a series of practice exercise work, to familiarize them with the various tools, the method of using them, and to learn the common practice in joinery and construction. For such a course the following exercises are well adapted for this purpose:

1. Squaring and planing exercise and sawing to lines.
2. Cross halved together, requiring close measurements in laying out, and the use of the chisel, in addition to all work required in No. 1.
3. Series of mortises. Giving method of chiseling through the wood, and requiring the use of the block-plane to finish ends of the work.
4. Mortise and tenon joint. This is one of the most common and useful methods of joining work, and various ways of applying this exercise could be suggested. This brings in the work found in No. 3.
5. Chiseling exercise, in which the use of the chisel is taught in cutting across the grain, diagonally across the grain, cutting curved surfaces, chamfering, and similar work.
6. Making bench-hook. This may be made of glued-up stock or plain stock. This is a necessary article of use, the pupil using it constantly at the work-bench. It brings into play the rip-saw cutting on an angle with the grain, cutting slots, and use of the brace and bit in boring holes.
7. Table leg with two rails, showing two methods of making the table leg, using the chisels; drawing-knife method of making and using dowel-pins.
8. These exercises will bring the pupil to the point where he will be able to join stock in doing glued work, and the eighth exercise may be glueing different woods together, and using it in making gavels, paper-weights, blotter-pads and similar articles.

This will keep the pupils busy for the first half-term. It is suggested that the next half-term be devoted to the making of small articles of use in which new methods are employed, and aiming constantly to give the new work such a turn that the pupil will be acquiring knowledge and skill, and to hold the interest of the pupil by making such articles as will be of use to him or in the home. The following are suggestions, and the good teacher will be able to vary these in such a way that the class will be thoroughly interested:

1. Towel-roller and towel-racks. 2. T-square. 3. Oilstone box. 4. Handkerchief and glove boxes. 5. Knife and fork box. 6. Picture-frame. 7. Easel. 8. Footstool.

The preliminary work such as is suggested may occupy the pupil the first half of the year, and let the last half of the year be devoted to cabinet work, in which larger articles are made. The making of mission furniture is a large field of suggestion for this part of the year's work.

EQUIPMENT.

The equipment consists of the following:

For each pupil. Bench, with front and end vise, jack-plane, block-plane, two-fold rule (2-foot), try-square, back saw, bench-hook, spoke-shave, sloyd knife, marking-gage, file, chisels (1″, ½″, ¼″), cutting-board, mallet, whisk-broom.

For general use. Rip-saws, cross-cut saws, hammers, screw-drivers, bit-braces, auger-bits ($3/16''$ to $15/16''$), expansive bit ($7/8''$ to $3''$), dividers, awls, countersinks, scraper, coping-saws, turning-saws, nail-sets, framing square, grindstone, oilstones, screw-clamps, gouges, carving tools, carving punches, hand drill, band-saw, lathe.

The following books are used for supplementary reading and for an acquaintance with the literature of manual training: Theory of Educational Sloyd, Solomon; Teachers' Handbook of Sloyd, Solomon; Sloyd for Upper Grammar Grades, Larsson; The Manual Training School, Woodward; Mind and Hand, Ham; Bench-work in Wood, Goss; Exercises in Woodwork, Sickels; Arts Crafts for Beginners, Sanford; School Arts Books, Manual Training Magazine, Notes on Mechanical Drawing, Mathewson; Mechanical Drawing, Tracy; New Methods in Education, Todd; Problems in Furniture Making, Crawshaw; Problems in Woodwork, Murray; and reports of the Council of Supervisors, Eastern Manual Training Association and Bureau of Education.

MECHANICAL DRAWING.

In connection with the joinery and cabinet work, a year of instruction in mechanical drawing may well be given to enable pupils to gain proficiency in the use of drafting instruments as a means of expression, familiarity with some of the simple, practical geometrical constructions, and a knowledge of orthographic projection with its application to the making of working-drawings. The course includes the making of twenty to twenty-five plates of drawings, consisting of exercise sheets, geometrical solids, working-drawings from a series of simple models, geometrical constructions, shadow projections, surface developments and problems illustrating isometric and cabinet projection and the intersection of solids. (See chapters on "Construction Drawing" in Prang's Art Education for High Schools.)

"True art is neither a superfluous nor a luxurious matter, but a national resource."

ART INSTRUCTION FOR HIGH SCHOOLS. *One unit.*

FIRST YEAR.

First term:

- Drawing from natural forms, as autumn flowers, seeds, plants, insects, in brush, pencil, ink and color.
- Adaptations of natural forms for purposes of decoration.
- Nature designs for motto illumination.
- Study of Egyptian units of decoration.
- Use of Egyptian units in cover design for drawing folio.

Second term:

- Color nomenclature.
- Scales of color.
- Color values in gray.
- Complementary colors.
- Color harmonies.
- Flat washes.
- Color harmonies applied to design.
- Study Greek design.
- Make cover design for drawing folio, using Greek unit.

Third term:

- Principles of design: arrangement of straight lines, curved lines, and dark and light values for balance and rhythm.
- Decorative use of landscape compositions in neutral values and corresponding color values.
- Nature drawing, spring flowers, trees, and landscapes, in pencil, brush, ink and color.
- Invention of animal, insect and flower forms for units of decoration.
- Cover design for folio for third term drawings.

SECOND YEAR.

First term:

Principles of perspective.

Outline drawings of objects in pencil, giving attention to proportions, perspective, spacing, quality of line, accent.

Interiors and exteriors of rooms; drawings of tables, chairs, etc.

Second term:

Outline drawing in pencil of groups of common objects.

Light and shade in soft pencil or charcoal, and if advancement of pupils will permit, in sepia.

Blackboard sketching with chalk and charcoal in three or five values.

Sketching on blackboard or tinted paper, with chalk and charcoal, animals, and the figure after good drawings.

Third term:

Study of color from nature.

Simple landscape compositions in water-color.

Still life and flower compositions in water-color.

Charcoal sketches from the pose, finishing with colored crayons.

MECHANICAL DRAWING.

THIRD YEAR.

First term:

Geometric problems. Rules to be observed in all mechanical drawing.

Second term:

Drawing to scale.

Working-drawings with tools and free-hand.

Developments.

Lettering.

Third term:

Projections.

Mechanical perspective.

HISTORY OF ART.

The following topics are suggestive only. The works of art studied will vary according to the facilities of the school. Teachers and students should bring to class all the pictures available for the study, remembering that artists' *works* are to be the subjects of interest and study. Pictures at small cost can be procured illustrating a most interesting and helpful course. Young People's Story of Art (Whitcomb) is recommended as an excellent text.

FOURTH YEAR.

First term:

Ancient art:

Egyptian: temples, tombs, pyramids, sphinx, painting.

Greek: The architecture and sculpture of the Acropolis, Jupiter Olympus, Venus de Milo, Apollo Belvedere: painting, Polygnotus, Zeuxis, Parrhasius, Apelles.

Roman: Orders of architecture, Coliseum, Arch of Titus, painting.

Second term:

Ecclesiastical art:

St. Sophia, St. Marck's, cathedrals of Milan, Cologne, Pisa; Giotto's Tower, St. Peter's; Ghiberti, Angelo's Moses, and David; Giotto, Angelico, Botticelli, Angelo, Da Vinci, Raphael, Correggio, Titian.

Third term:

Velasquez, Murillo, Rubens, Van Dyck, Rembrandt, Hobbema, Ruysdael, Durer, Reynolds, Constable, Landseer, Corot, Millet, Bonheur, Rousseau, Burne-Jones, Sargent. American mural decorations by leading artists.

A comprehensive and valuable guide for working out in detail the foregoing course is Art Education for High Schools, published by the Prang Educational Company, New York and Chicago.

MUSIC.

The difference of attainment in individual pupils and the difference in amount of grade preparation is so great in music that it is difficult to outline a high-school course in music suited to the varied conditions. Chorus practice for the entire high school is recommended, for which, as well as for outside orchestral and glee-club work, a minor credit might be given for graduation. Where regular work is organized for credit the following arrangement for a two-year course is suggestive:

FIRST YEAR.

One period:

Monday, elementary harmony.
Tuesday, sight-singing, ear training and rhythm drill.
Wednesday, elementary harmony.
Thursday, chorus practice (entire high school).
Friday, musical interpretation (song-form, rondo, sonata, symphony, suite, etc.).

SECOND YEAR.

One period:

Monday, advanced harmony.
Tuesday, sight-singing, ear training and rhythm drill.
Wednesday, advanced harmony.
Thursday, chorus practice (entire high school).
Friday, musical history (art itself and lives of composers).

AGRICULTURE.

A SECONDARY COURSE IN AGRONOMY.[1]

Since your committee four years ago reported on secondary courses in agriculture interest in instruction in courses below college grade has continued to increase, and the demand for a definite program for use in high schools has become insistent. The committee has considered it wise to undertake to meet this important demand.

In its former report[2] a number of tentative schedules for high-school courses were presented to show the place of agriculture in such courses and to show that agricultural courses may be offered in the schools without any violent or radical reorganization of existing programs for such schools. The committee dealt with the schedule of the ordinary high school, and not that of special agricultural high schools or other forms of secondary agricultural schools. In the syllabus and the outline of lectures, demonstrations, laboratory exercises and recitations which are submitted in this report it is assumed that agriculture will be related to the high-school course as a whole, as will Latin, algebra, chemistry, physics, botany, or any other subject of study.

The probable and possible teaching force, the facilities for instruction, and the exigencies of a high-school schedule have been carefully considered. The committee has deemed it more important to outline a course of study that can be used by the high schools than to have it at all points pedagogically consistent. In preparing this outline the committee has availed itself of the services of a graduate of both a scientific and an

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1. Report of the Committee on Instruction in Agriculture of the Association of American Agricultural Colleges and Experiment Stations.

2. Seventh Report of the Committee on Methods of Teaching Agriculture, U. S. Dept. Agr., Office of Experiment Stations Circ. 49.

agricultural course, who has had several years' experience in high-school instruction.[3]

The term agriculture as applied to courses of instruction should be used to include in a comprehensive way the science and practice of the production of plants and animals useful to man and the uses of such plants and animals as far as these are closely connected with their production. Agriculture may be divided into (1) plant production, (2) animal production or zoötechny, (3) agrotechny or agricultural technology, (4) rural engineering, and (5) rural economics.

Plant production includes whatever relates to the natural or artificial environment (*i. e.*, climate, soil, water, fertilizers, etc.) of useful plants, their structure, composition, physiology, botanical relations, varieties, geographical distribution, culture, harvesting, preservation, and uses, and the obstructions to their growth, preservation, or use. Plant production may be subdivided into agronomy, which deals with what are commonly called field or farm crops; horticulture, which deals with vegetables, fruits, and ornamental plants; and forestry, which deals with trees and shrubs grown in large tracts.

Animal production or zoötechny includes whatever relates to the anatomy, physiology, zoölogical relations, domestication, types and breeds, breeding, feeding, hygiene, management, and uses of useful animals. It may also include diseases and other impediments to the production of animals, *i. e.*, veterinary medicine.

Agrotechny includes whatever relates to the conversion of raw materials produced in agriculture into manufactured articles for use in commerce and the arts, as far as such manufacture is closely connected with agriculture; *e. g.*, dairying and sugar-making.

Rural engineering includes those branches of civil and mechanical engineering which relate to the locating, arranging and equipment of farms and plantations and the construction and operation of implements and machinery in agriculture. It embraces such subjects as roads, drains, irrigation, farm buildings, etc.

Rural economics is a somewhat elastic term, but includes at least whatever relates to the production, preservation and distribution of wealth by the use of land for the growing of plants and animals. It may include the development of agriculture as a business (history of agriculture) as well as the facts and principles of farm management under present conditions.

In the minds of the committee, agricultural instruction in the high school may properly fall into two groups: Group I, agronomy, rural engineering, and rural economy; and group II, zoötechny and dairying. It is recommended that group I, or agronomy, occupy the junior year, and group II, or zoötechny, occupy the senior year. It is the purpose, however, to have the outline of daily exercises sufficiently flexible to make it possible for high-school authorities to adapt it to the exigencies of their schedules and also to permit emphasis being placed upon the forms of the industry most important to the immediate neighborhood of the school. Thus, if only one year can be given to the subject, certain exercises may be omitted to bring the instruction within the compass of the time allowed, and if the main industry is one requiring special emphasis being placed upon fertilizers, or irrigation, or upon a particular crop, such as cotton, then these subjects will be selected for fullest discussion, although not necessarily omitting entirely other subjects.

At this time a report is made upon the subject of agronomy, it being the purpose of the committee to make a similar report upon zoötechny later. Strictly speaking, agronomy deals only with the theory and practice of the production of farm crops, including the study of climate, soils, fertilizers, and other matters closely related to crop production. In this report, however, the committee has thought it best to include a few lessons

3. Dr. G. F. Warren, assistant professor of agronomy, Cornell University.

on horticulture and forestry in cases where publications and illustrative material are available for such study. This is done with a view of encouraging some attention to the growing of vegetables and fruits, the eradication of insect pests and diseases of plants, and the management of the wood-lot on the ordinary farm. It is hoped and expected that in the near future the committee will be able to offer suggestions for more extended secondary courses in both horticulture and forestry. The course of study outlined in this circular is based upon the assumption that the study of agriculture will be preceded by botany, physiology, and, if possible, chemistry, and that the text-books used or the class of subjects discussed under each science will be those most important to a clear understanding of agronomical teaching.

SYLLABUS ON AGRONOMY FOR SECONDARY INSTRUCTION.

The following syllabus has been prepared not only to give the teacher the limits of the subject to be taught, but to present the point of view from which the subject should be taught. A Japanese scholar, while speaking before an American audience recently, remarked: "I noticed one very marked difference in the agriculture of Europe and America from that of Japan. In Europe and America you work the soil; in Japan we are interested in growing crops." This syllabus has been prepared from the Japanese point of view, namely, that the aim in agronomy is the production of plants useful to mankind, a definition this committee gave to agronomy in its third report in 1898.

In this syllabus emphasis is not placed upon soil, tillage, drainage and irrigation as such, but upon the relation of soil, tillage, drainage and irrigation to the environment of the plant, namely, to light, heat, moisture, air, plant-food, and repressive agencies. The special providence of the agronomist is to consider how soil, tillage, drainage, irrigation and the various cultural methods of the farmer may modify the environment and thus increase the crop, and, so far as man may modify the environment, how it may be accomplished economically. No less important is the influence of heredity in the production of crops and the practical methods by which plants may be improved.

To what extent the teaching will be confined to a consideration of man's influence in making use of fundamental laws and how much time will be employed in stating fundamental laws must depend upon the thoroughness with which the student has studied botany, physiology, and chemistry.

In any case the application of these fundamental laws must be made. For example, if the students have had chemistry, the teacher must spend some time in considering the function and relation of the fourteen elements chiefly concerned in the production of soil, air, plants, and animals. If, however, the students have not had any chemistry, it will be necessary in addition to spend some time in teaching the students the alphabet of chemistry. From the syllabus it will be seen that the plant may be studied from the standpoint of its composition, structure, physiology (activities), heredity, and environment. Since a plant is the result of two forces, its heredity power and its environment, general consideration is first given to the methods of plant improvement and to those cultural methods by which the plant's environment is modified. Following these general considerations each individual crop may be studied from the standpoint of its structure, its composition, its physiology or activities, its heredity or improvement, its environment or cultural methods, and, finally, its economical use and disposal. The number and kind of crops to be studied will vary with the time at the disposal of the teacher and, to some extent at least, with the character of the local agricultural industries. The syllabus outlines an illustration of the order and possible topics for discussion, leaving it to the teacher to select those that may be best employed. It is not expected that any high school will be able to teach all the topics here mentioned.

Syllabus.

1. The plant, how studied:
   1. Composition.
   2. Structure.
   3. Physiology.
   4. Heredity.
   5. Environment.
2. Composition:
   1. Essential elements.
   2. Function of elements.
   3. Water.
   4. Ash.
   5. Protein.
   6. Carbohydrates.
      1. Cellulose.
      2. Starch.
      3. Sugars.
   7. Fat.
3. Structure:
   1. Cells.
   2. Roots.
   3. Stems.
   4. Leaves.
   5. Inflorescence.
4. Physiology.
   1. The plant activities.
   2. The processes of growth.
   3. Irritability.
   4. The kinds of propagation.
   5. Propagation by seeds.
   6. Propagation by buds.
5. Heredity:
   1. Principles.
   2. Processes.
   3. Steps in improvement of plants.
      1. Variation.
         1. Environment.
         2. Crossing.
      2. Selection.
      3. Testing hereditary power.
   4. Illustrations of improvement in plants.
   5. Methods of improvement.
6. Environment:
   1. Light.
   2. Heat.
   3. Moisture.
   4. Air.
   5. Plant-food.
   6. Repressive agencies.
7. Light and heat:
   1. Relative interdependence.
   2. Effect.
   3. Influence of character of light.

7. Light and heat—*continued:*
   4. Influence of seasons.
   5. Temperature for germination and growth.
   6. How modified.
      1. Color.
      2. Evaporation.
      3. Topography.
      4. Character of soil.
      5. Cultivation.
      6. Drainage.
      7. Rolling.
      8. Thickness of planting.
      9. Fermentation.
      10. Artificial means.
          1. Screens.
          2. Electricity.
          3. Artificial heat.
8. Moisture:
   1. Purpose.
   2. Importance.
   3. Quantity required.
   4. How modified.
      1. Kind of soil.
      2. Topography.
      3. Fertilizers and other amendments.
      4. Cultivation.
      5. Drainage and irrigation.
9. Air:
   1. Function above ground.
      1. Oxygen.
      2. Carbon dioxid.
   2. Function in soils.
      1. Oxygen.
      2. Nitrogen.
      3. Removal of carbon dioxid.
   3. Processes of soil ventilation.
      1. By diffusion.
      2. By expansion and contraction of air due to temperature.
      3. By expansion and compression due to barometric pressure.
      4. Suctional effect of gusts of wind.
      5. Air absorbed by rain-water.
      6. By removal of water, through drainage, evaporation, and transpiration of plants.

10. Plant food:
    1. Elements needed.
        1. Function.
        2. Sources.
            1. Air.
            2. Soil.
            3. Fertilizers.

11. Soil:
    1. Functions.
    2. Properties.
    3. Kinds.
    4. As a source of plant-food.
        1. Importance compared with other sources.
        2. How modified.
            1. Kind of soil.
            2. Topography (erosion).
            3. Tillage.
            4. Drainage and irrigation.
            5. Fertilizers.
            6. Systems of cropping.

12. Kinds of soil.

13. Topography.

14. Tillage:
    1. Purpose and effects.
    2. Methods.

15. Drainage:
    1. Purpose and effects.
    2. Methods.

16. Irrigation:
    1. Purpose and effects.
    2. Methods.

17. Fertilizers:
    1. According to constituents.
        1. Nitrogenous.
        2. Phosphoric.
        3. Potassic.
        4. Other amendments.
    2. According to form.
        1. Farm manures.
            1. Green manures.
            2. Animal manures.
        2. Commercial fertilizers.

18. Farm manures:
    1. Properties.
    2. Sources.
    3. Uses.
    4. Preparation, care, and handling.
    5. Application.
    6. Economy.

19. Commercial fertilizers:
    1. Sources.
    2. Uses.
    3. Application.
    4. Economy.

20. Nitrogen:
    1. Source.
    2. Fixation of free nitrogen.
        1. With certain plants.
        2. Without plants.
        3. Organisms.
        4. Cause of tubercles.
        5. Effect of organisms.
        6. Influence of conditions.
    3. Nitrification.
    4. Denitrification.
    5. Loss through drainage.

21. Repressive agencies.
    1. Insects and other animals.
    2. Diseases.
    3. Weeds.
    4. Unfavorable weather.
    5. Acidity and alkalinity of soil.
    6. Toxic agencies.

22. Rotation of crops:
    1. Principles.
    2. Systems.

23. Classification of economic plants:
    1. Cereals.
    2. Grasses.
    3. Legumes.
    4. Vegetables.
    5. Fruits.
    6. Tubers.
    7. Roots.
    8. Sugar plants.
    9. Oil plants.
    10. Fiber plants.
    11. Stimulants.
    12. Medicinal and aromatic plants.

24. Cereals:
    1. Wheat.
    2. Indian corn (maize).
    3. Oats.
    4. Barley.
    5. Rye.
    6. Rice.
    7. Sorghum.
    8. Buckwheat.

    (Other groups of plants may be classified in like manner.)

25. As many individual crops may be treated as time will permit.

An outline of topics on wheat is submitted, which is believed to be much too complete for secondary instruction, but may be readily modified to suit the character of instruction required.

WHEAT.

A. Structure:

1. Relationships; 2, roots; 3, culms; 4, leaves; 5, tillering; 6, organs of reproduction; 7, the true flower; 8, the spikelet; 9, the spike; 10, the grain; 11, the embryo; 12, the endosperm; 13, the aleurone layer; 14, the bran; 15, physical properties.

B. Composition:

1. Composition; 2, water; 3, ash; 4, protein; 5, gluten; 6, relation of weight per bushel to nitrogen content; 7, influence of environment on composition of grain; 8, germination.

C. Botanical relations:

1. Species of wheat; 2, Einkorn; 3, spelt; 4, emmer; 5, common wheat; 6, club, or square-head wheat; 7, Poulard wheat; 8, durum wheat; 9, Polish wheat; 10, spring and winter wheats.

D. Classification of varieties:

1. The importance of variety; 2, the best variety; 3, variety names; 4, pedigree wheat; 5, number of varieties; 6, variety characteristics; 7, variety groups; 8, desirable qualities; 9, score-card; 10, market classification; 11, soft winter varieties; 12, hard winter varieties; 13, hard spring varieties; 14, white varieties.

E. Improvement of varieties:

1. New varieties; 2, the introduction of foreign varieties; 3, improvement by selection; 4, varieties through crossing; 5, the possibility of cross-fertilization; 6, the law of cross-fertilization; 7, importance of crossing as a method of improvement; 8, method of finding and testing new strains or varieties.

F. Climate:

1. Conditions of successful wheat culture; 2, effect of climate upon geographical distribution; 3, effect of climate upon quality; 4, effect of climate upon growth; 5, accumulation of soil constituents at different stages of growth; 6, winter-killing.

G. The soil and its amendments:

1. The choice of soil; 2, effect of change of soil on yield; 3, the use of fertilizers; 4, indirect fertilization; 5, rotations; 6, carriers of fertilizing constituents; 7, relative importance of fertilizing constituents; 8, amount of fertilizers; 9, time and manner of applying commercial fertilizers; 10, farm manure; 11, mulching.

H. Cultural methods:

1. Time of plowing; 2, depth of plowing; 3, preparing seed-bed without plowing; 4, time of sowing; 5, depth of sowing; 6, drilling compared with broadcasting; 7, quantity of seed per acre; 8, influence of size of seed; 9, treatment of seed; 10, wheat-seeding machinery; 11, cultivation; 12, rolling.

I. Weeds, fungus diseases, and insect enemies:

1. Weeds: (*a*) chess or cheat; (*b*) darnel; (*c*) cockle; (*d*) wild garlic; (*e*) wheat-thief; 2, fungus diseases: (*a*) rust; (*b*) wheat-scab; (*c*) loose smut; (*d*) stinking smut; 3, insect enemies of growing wheat: (*a*) chinch-bug; (*b*) Hessian fly; (*c*) wheat joint-worm; (*d*) wheat-midge; (*e*) grain aphides; (*f*) army-worm; (*g*) grasshoppers.

J. Harvesting and preservation:

1. Date of harvesting; 2, influence of maturity on yield; 3, influence of ripening upon composition; 4, influence of shocking; 5, method of shocking; 6, methods of harvesting; 7, self-rake reaper; 8, the self-binding harvester; 9, the header; 10, the combined harvester and thrasher; 11, thrashing; 12, storing; 13, elevators.

K. Uses and preparation for use:

1. Uses; 2, food for domestic animals; 3, source, amount and quality of flour; 4, grades of flour; 5, Graham and entire-wheat flour; 6, amount of bread from flour; 7, milling machinery; 8, purifier; 9, the by-products of wheat; 10, composition of by-products; 11, food value of by-products.

L. Production and marketing:

1. Wheat crop of the world; 2, wheat crop of the United States; 3, progress of wheat production; 4, center of wheat production; 5, winter wheat and spring wheat; 6, production of flour; 7, consumption of wheat per capita; 8, yield per acre; 9, cost of production; 10, export of wheat and flour; 11, imports of wheat; 12, commercial grades.

M. History:

1. Antiquity; 2, original habitat; 3, reasons for culture.

GENERAL INSTRUCTIONS TO TEACHERS.

Since this is a new subject for high-school work it seems desirable to give detailed suggestions on a few subjects for study. These directions and questions are not intended to be mandatory, but are intended to help teachers who are giving this work for the first time. This work does not cover the entire syllabus. When the schools and teachers become better equipped the work may be extended. In preparing these lessons first attention has been given to the question as to whether bulletins and other material could readily be secured. Some topics of prime importance have been omitted because there are no bulletins that can be secured to supply the entire class for study, while topics of less importance have been included because good bulletins are available. The lessons are to aid in doing work under present conditions and are not intended to represent an ideal high-school course.

The study of agriculture gives the same sort of educational development as is given by the study of botany, physiology, physics, chemistry, and other sciences. From the unlimited number of subjects for scientific study it selects those which concern the plants and animals that are used on the farm. Each school should select for study the subjects that are of greatest importance in the community.

Since agriculture is based on so many sciences it is desirable that it follow the study of the other sciences that are taught in the school, particularly botany and chemistry. If a school cannot teach chemistry it will be possible to give about two-thirds of the lessons outlined. But it is extremely desirable that chemistry be taught preceding the agriculture. It should be taught by the laboratory method. No work in high-school agriculture should be attempted unless the school teaches botany. Those who wish to teach agriculture before they teach botany should use Office of Experiment Stations Bulletin 186, Exercises in Elementary Agriculture—Plant Production. Many of the exercises in that bulletin can also be used in high-school work.

The student should thoroughly understand plant-cells, from a microscopical study of them; the embryo and its growth; tests for starch and proteids; the process of osmosis and the function of roots; the structure of stomata and use that the plant makes of oxygen and carbon dioxid;

the formation of starch, its transfer through the stem, and its deposit as stored food in seeds and tubers; the process of fertilization; the nature of a fungus disease, from a microscopical study of bread mold or other fungus.

All other science work that is taught will help in agriculture. The subjects under physiology that are of most value as a preparation for agriculture are: Respiration; the kinds of foods, their digestion, and the part that each plays in keeping up the body; bacteria and sanitation. If physical geography or geology is taught, the subjects of most value in preparing for agriculture are: The air, the weather, and the formation of soils. If zoölogy is taught, the work on insects will be of most value in preparing for the following lessons.

The teacher who gives the elementary agriculture should have a good knowledge of elementary botany and chemistry, and it is very desirable that he have some knowledge of physics, zoölogy and geology. It is also desirable that the teacher be a man who has had some farm experience or who has studied some agriculture.

REQUIRED FREE REFERENCES.

Write to each of the following addresses, stating that you wish the publication mentioned for your high-school library and in your class in agriculture. If the teacher finds that he desires any of these for his private library, he should write for additional copies. The set in the high-school library should be kept complete for future classes. On receipt of these the loose bulletins should be bound, or they may be punched and tied together with strings, and manila paper may be used for covers. These should be put in some place where pupils will have free access to them.

(1) Secretary of Agriculture, Washington, D. C.: Ask to have the school placed on the mailing-list for the Monthly List of Publications, and to be sent the following: One set of Farmers' Bulletins suitable to the locality; one copy of the List of Publications for Free Distribution; one copy of the List of Bulletins for Sale; one copy of each of the reprints of the areas that have been surveyed by the Bureau of Soils in your state. Also ask for as many copies of "Separates from the Yearbook," Nos. 83, 124, 159, 279, 310 and 329, as there are students in the class. One copy of this circular and of Office of Experiment Stations Bulletin 186 for each student will be convenient for some of the exercises. Also look over the list of recitations where pupils are to study Farmers' Bulletins. Make a list of these bulletins that you expect to use, and send for as many copies as there are students in the class. Where directions are given to "study and recite" on bulletins or extracts, it is expected that the teacher give out a copy to each pupil at the time when the lesson is assigned.

(2) Write to your congressman for such copies of the Yearbook of the Department of Agriculture as he may have for distribution, stating that they are for your high-school library.

(3) Write to your State Experiment Station for copies of available bulletins and reports, and ask to be placed on the mailing-list.

(4) Write to the State Board of Agriculture and other agricultural societies for publications that they have for distribution.

(5) Copies of farm papers and country-life magazines are desirable for the high-school reading-table.

BOOK REFERENCES.

No references other than the above are absolutely necessary, but it is very desirable to have on the reference table one copy of as many of the following books as possible. At least half of these ought to be secured. If a cyclopedia of agriculture can be afforded it will be of much value. Several copies of each of the first four books will be desirable if the

class numbers over half a dozen; also of the fifth book in regions where fertilizers are much used:

1. Physics of Agriculture, King.
2. Chemistry of Plant and Animal Life, Snyder.
3. Forage and Fiber Crops in America, Hunt.
4. Cereals in America, Hunt.
5. Fertilizers, Voorhees.
6. Experiments with Plants, Osterhout.
7. The Principles of Fruit Growing, Bailey.
8. The Fertility of the Land, Roberts.
9. The Farmstead, Roberts.
10. The Horticulturist's Rule Book, Bailey.
11. Corn Plants, Sargent.
12. The Practical Garden Book, Bailey.
13. The Soil, King.
14. Irrigation and Drainage, King.

The following are more elementary books:

15. Soils and How to Treat Them, Brooks.
16. Manures, Fertilizers, and Farm Crops, Brooks.
17. Principles of Agriculture, Bailey.
18. Agriculture for Beginners, Burkett, Stevens, and Hill.
19. First Principles of Agriculture, Goff and Mayne.
20. Elementary Agriculture, Bessey and others.
21. Agriculture through the Laboratory and School Garden, Jackson and Daugherty.
22. First Book of Farming, Goodrich.

EQUIPMENT.

It is desirable that the high school be equipped for regular laboratory work in botany, chemistry, and physics. If not so equipped, the following equipment is suggested for a class of ten in agriculture:

2 compound microscopes magnifying to 500 diameters; cost, about $18.
2 balances for weighing to centigrams.
Spring balance.
1 dozen pint fruit-jars.
1 dozen quart fruit-jars.
4 dozen test-tubes.
½ dozen beakers (drinking glasses may be substituted).
1 dozen 4-inch size flower-pots with saucers; 1 dozen 6-inch flower-pots with saucers (tin cans and boxes may be substituted).
1 gasoline burner (a stove or laboratory burners are as good).
6 porcelain crucibles (iron spoons may be substituted).
2 thermometers.
Small magnifying glasses, magnifying 10 diameters.
1 "school set of economic seeds." These may be obtained at a nominal expense by writing to the Seed Laboratory, United States Department of Agriculture, Washington, D. C.

Other equipment required can be brought from home by students when it is needed.

It is essential that there be at least two windows at which plants may be kept growing for experimental purposes.

Whenever possible, it is desirable that several acres of land be available for school use. Those who are laying out new school grounds will do well to keep this in mind.

COLLECTION OF MATERIAL.

About one bushel each of sand, such as is used in plastering, sandy loam soil and clay should be collected. Similarly collect about three quarts of leaf mold (well-rotted leaves). Also collect about four quarts of soil and subsoil from the same spot. All these should be put in the basement, where they will become air-dry for future class use. It is also

desirable to have several bushels of good rich soil for use in growing house plants. Unless it is very rich, about one-fourth stable manure should be mixed with it.

Collect samples of the common diseases and insects for class study. Any of the following diseases or others that occur in the neighborhood: Potato-scab, apple-scab, wheat-rust, oat-smut, brown rot of peaches and plumbs, blak-knot, apple-canker, corn-smut.

Fill two one-quart jars with pure rain-water for use in No. 22, unless you can distill water.

The following samples of fertilizers for exercise may be secured from a local dealer, or students may be able to bring them in, or they may be secured from the manufacturers. Secure the guaranty analysis and price of each sample. Get about one pint each of nitrate of soda or other form of nitrogen, muriate of potash or other form of potash, acid phosphate or other form of phosphoric acid, and at least two samples of complete fertilizers.

NOTE-BOOKS.

Each student should keep a note-book, in which all field trips, demonstrations and laboratory work should be written up, giving date, subject of the exercise, materials used, full description of how the work was done, drawings, all data secured, solution of problems, answers to questions that follow the demonstration and laboratory work or to similar questions prepared by the teacher. This should all be given in complete form in good English, not in detached sentences. This really amounts to a discussion or essay on the subject, in which drawings, problems and answers to questions are included.

Many of the demonstrations are of such a nature that they may be assigned to some student in the class, who will take entire charge of the preparation and management of the experiment. This may not very greatly reduce the work of the teacher, but it will be of much value to the students. The note-book discussion of demonstrations should state who did the work.

TIME REQUIRED.

The work here outlined is expected to be sufficient for one year. It can readily be adapted to half this amount of time by omitting exercises. It is desirable that there be three recitations a week and two double periods for laboratory work, field-work, and demonstrations. When a field lesson is given, it is desirable that it be the last work of the day, so that it need not be finished at any scheduled time. The demonstration work may often be given in recitation periods. The figure in parentheses following the number of the exercise indicates the relative time that it is thought desirable to devote to the subject. More than this number of periods can be given to each topic and still complete the work in a year. This will give an opportunity to devote more time to those lessons that are of particular interest in the community. By securing the bulletins from the State Experiment Station, a study may be made of the agriculture of the state.

OUTLINE OF LECTURES, RECITATIONS, DEMONSTRATION AND LABORATORY WORK FOR SECONDARY INSTRUCTION IN AGRONOMY.

I (2) RECITATION. What is agriculture? Agronomy?

The teacher may give a talk on this subject, showing how agriculture rests on many sciences and the things with which agriculture deals. (See syllabus.) Then, taking up agronomy, call attention to the ways in which plants may be studied: 1, composition; 2, structure; 3, physiology; 4, heredity; and 5, environment.

High-school botany, as taught at present, deals chiefly with structure and physiology. We will now take up the study of plants in all five ways, but will give most attention to environment and heredity. Little can be given on composition without a knowledge of chemistry.

When studying about light, heat, air, moisture, soils, tillage, drainage, etc., always keep in mind that these are not being studied as independent subjects, but are studied because they are important factors in the plant's environment.

II (2) FIELD LESSON. Variation in plants.

Materials.—A field of corn; tape measure.

If there is danger that there will be no corn convenient, the teacher can get some one to leave a dozen hills or more uncut for this study, or a similar study may be given on another crop. The lesson may be given at any time during the fall. Each pupil to bring a tape measure from home. It is best to have the measurements made on different rows to secure independent work. Each pupil to work on ten hills, or ten stalks, if drilled or listed.

Number of hills, ———.
Number of stalks per hill, ———.
Number of suckers, ———.
Number of ears, ———.
Number of hills missing, ———.
Total stalks, ———.
Number of barren stalks, ———.
Average ears per stalk, ———.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Height of ten stalks	......	......	......	......	......	......	......	......	......	......
Height of ear	......	......	......	......	......	......	......	......	......	......
Length of shank of ear	......	......	......	......	......	......	......	......	......	......
Length of ear	......	......	......	......	......	......	......	......	......	......
Direction of ear	......	......	......	......	......	......	......	......	......	......
Number of leaves	......	......	......	......	......	......	......	......	......	......

Suckers are side branches that come out from a stalk usually near the ground. The shank is the stem that holds the ear. Direction of the ear is horizontal or pointed upward or dawnward. A long, slender shank usually allows the ear to point downward. If it points upward, water is more likely to go into the ear and cause it to rot if left standing in the field. The husks may be pulled back to measure the ear. Notice the very great variation in each character. Why is this so? There must be a difference in the strength of different plants—an individuality. From which would we select seed? Find a stalk and ear that you think would be a good one to save for seed. It should not be good merely because it had more room to grow, but be good under the usual conditions. What uncertainty about its being good? Notice that pollen may have come from a poor stalk.

III (2) RECITATION. Selection of seed corn.

Study and recite on the above and on Farmers' Bulletin No. 229.

IV (1) FIELD LESSON. Variation in potatoes.

Materials.—Spring balance, pail, spading fork or potato hook.

Dig twenty or more hills of potatoes. Weigh and count the large (marketable size) and small potatoes.

HILL.	Large.		Small.	
	Number.	Weight.	Number.	Weight.
1........	....	....	....	....
2........	....	....	....	....
Etc.				

Notice the variation in individual hills. Which hill would be the most desirable for seed? If all the large potatoes were used for seed, would you have only the good plants represented? Some boy will probably volunteer to do this work and report his results to the class.

V (3) RECITATION. Plant-breeding.

Read and recite on Separate No. 83, Yearbook 1896 (Influence of Environment on the Origination of Plant Varieties) ; also have the pupils look over and read parts of Separates Nos. 124, Yearbook 1897 (Hybrids and their Utilization in Plant Breeding), and 159, Yearbook 1898 (Improvement in Plants by Selection).

The following points need to be brought out: The great variation in plants; any change in environment increases the variation; possibilities of improving cultivated varieties by selection; how hybrids are made; great variations thus caused; these variations may be desirable or otherwise; they furnish opportunity for selection; in selecting seed the entire plant should be considered, not a single potato, but the best hill; if selected from a pile, a good-looking potato might have been the only good one in the hill. What would be a good way to select tomato seed? Corn seed? (Cereals in America, pages 14-26.)

This outline, with sample lessons, is taken from Circular 77, which every teacher is urged to obtain by writing to the Office of Experiment Stations, Washington, D. C.

Group IX.

SCHOOL MANAGEMENT AND METHODS. *One-half unit.*

SCHOOL MANAGEMENT.

I. Introduction.

Definition. Relation to method. School law the basis. Teachers' experience the guide.

II. The school.

Laws organizing and controlling the school.
Kinds of schools provided for.

III. The teacher.

Who should enter the work; physical requirements; temperamental and personal requirements; educational requirements (branches of study, arts, industries).
Sources of educational equipment.
- Common schools; limitations.
- Normal institutes; law organizing and controlling; county superintendent's relation to same; who may conduct or teach.
- Normal schools.
  - Where located; purposes of their organization; courses of study offered.
- Other state schools and colleges.

Certificates.
- Laws controlling their issue; kinds of certificates, sources; county superintendent; county high-school diploma; normal school "one-year," "three-year," and "life" certificates; university and college diplomas; examinations, when and where; validating certificates in other counties than those issuing same.

Duties of teacher.
- Legal; as to school board, school property, keeping records, making reports, control of pupils.
- Classification of pupils; basis of, how lessen number of classes, daily program.
- Following course of study.
- Relation to county superintendent.
- Attending associations.
- Reading-circle work.
- Opportunities and duties as a member of the community.
- How to keep growing.
  - Private study, general reading, summer schools, the year off, district and state association meetings.

IV. The patrons.

Their proper attitude toward their school.
School meeting; what patrons can do at school meeting.
Attitude towards punctuality, compulsory attendance law, tardiness, discipline.
Feeding, clothing, and care of child attending school; amount of labor they should be required to do; school lunches; school dress and shoes; sleep; conditions for home study and reading.

IV. The patrons—*continued:*

Home criticism of school and teacher.
Visiting the school, inviting the teacher to visit the homes.
Liberality of views and interest in children's progress.
Assisting in discipline.
Parties and evening entertainments.

V. The children.

Age at which they may enter kindergarten; primary school.
Individual differences as to health, condition of eyes, ears, touch, taste, smell, motor ability, temperament, fatigue, nutrition, nervousness, acquired habits, disposition, adolescence.
Condition of the schoolhouse as to ventilation, light, heat, desks, cleanness, cheerfulness, decoration.
School grounds, portions set aside for games, for garden, ornamentation of grounds.
Games suitable for out-door athletics. Toilet accommodations. Defacing property.

VI. Teaching.

(The course in methods treats of this phase of management more specifically.)
Classification.

The state course of study; grading; promotions; reports to parents; study, how to do it; supervision; helping pupils get their lessons; home assistance; written work; drawing; music; special programs; social forms; morals; physiology and hygiene; social occupations, manual work, sewing, cooking, gardening, etc.

VII. Discipline.

The ideal school; attitude of teacher toward pupils; how much governing is necessary; suggestion; imitation; self-government by pupils; inculcating good habits; power of mutual acquaintance; governing through interest in the school and its work; making rules and regulations; punishment; assistance from parents.

METHOD IN TEACHING.

1. Aims in education.
   General aims; special aims.
2. Scope of method.
   How educational changes are to be brought about.
   Impression and expression, or stimulus and response.
   The stimuli classified; responses classified.
3. The scientific basis of teaching.
   Physiology and hygiene; psychology; ethics; sociology; biology. Not all of these sciences, but some parts of each.
4. The instincts and capacities of children.
   Instincts defined; instincts most important in education; general capacities; special capacities.
5. Self-activity.
   Meaning of term; its importance; its relation to good teaching.
6. Apperception.
   Meaning; a law of teaching; its application.
7. Interests.
   Meaning of interests; direct and indirect; value of permanent interests; use of indirect interests in learning; how to secure interest; no accomplishment without interest; what interests are best.

8. Individual differences in children.
   How great; how to treat slow, dull children; how to treat precocious children.
9. Attention.
   Nature of; how important; how secured; how held; improper methods of securing.
10. Habit formation.
    Law of habit; the application of the law to teaching.
11. Memory.
    How we remember; best kinds of memory; how to acquire habits of memorizing; how to train children's memories; value of memory.
12. Correlation.
    Meaning of term; how to apply it to teaching; avoid trivial or unnatural correlations.
13. The individual and the general notion.
    The individual notions defined; sources of individual notions; general notions defined; origin and growth of general notions; difficulty of getting accurate general notions; distinguishing marks of individual and general notions; relationship between them; the value of general notions; which should precede; how to acquire individual notions; the use of apperception; stating the aim; the first or preparatory step.
14. Presentation.
    Ways of presenting new matter; lecture; text-book; development; limitations of each method; necessity for vivid imagery; value of reviews.
15. The step of comparison and abstraction.
    Meaning of terms; how this step is made.
16. Generalization.
    Need of good statement made by pupil.
17. Application.
    When shall the application of general notions be acquired; how can the school provide for application; application deductive; reviews as a form of application; reasoning as a form of application.
18. Type lessons.
19. Education and conduct.
    The elements of good character; the limitations of the schools in the realm of moral training; the application of the law of habit to moral training; the law of suggestion and its application to moral teaching; discussing wrong acts before children; the opportunities the school offers for moral action; the value of specific moral instruction; the moral judgment; moral effects of school studies; semi-moral habits.
20. Emotional responses.
    Their likeness to responses of thought and action; instincts of emotional response; habits of emotional response; the aesthetic emotions.
21. Motor education.
    Kinds of motor responses possible; their value; their training.

PSYCHOLOGY. *One-half unit.*

Psychology is fundamental in the theory and practice of education. It is therefore properly included in this Normal course of study. The teacher should understand the laws of mental activity, how the mind develops, and when the different powers appear.

In beginning a course in the study of psychology it is well for teacher and students to note some of the special difficulties of the subject. One of the chief of these lies in its very nature. It is a new field to the student—almost like entering a new world, in fact. Heretofore life and thought have been objective. The young person has been taken up with the sights and sounds, the world of things. Now he must practice observing the working of his own mind, a process technically called introspection.

No one ever learned psychology from a text-book. However helpful a good text is in directing the thought in a systematic way, it will avail little if the student fails to refer at every point for verification to his own mind.

There is need of making the subject as concrete as possible by illustration and simple experiment. The teacher should insist on pupils drawing their illustrations from their own experience rather than using those given by the text. Progress also will be slow until the student gains some mastery of the special vocabulary of the subject. The technical meaning of sensation, perception, concept, judgment, and many others, must be acquired. It will not do for the teacher to assume that the members of the class understand these new and more or less abstract terms.

During the whole course of this study seek at every point to develop the idea of the unitary character of the mind. The mind acts as a whole, though sometimes one phase happens to be emphasized, then another. At such times we say that we are perceiving, remembering, or reasoning, as the case may be. For purposes of study, indeed, we may single out a certain process, but all are interrelated and represented in every other. These correlations should be constantly held in mind. As an instance of this take apperception, which may profitably come in for consideration when dealing with perception, attention, interest, memory and volitional action.

Before dropping a chapter the pedagogical applications should be dwelt upon. A fault with much teaching of psychology is that it is considered purely in its scientific aspects. Even so it may be made an intensely interesting subject to young people by a skillful teacher, but when a prospective teacher sees how it is going to help him in a practical way it will put a new light upon it.

As a preparation the student should have some knowledge of the physiology of the nervous system. Otherwise, any discussion of the relation of mind and body, of evidence that the brain is the organ of the mind, will be vague. From the beginning there should be insistence on the dynamic or active character of consciousness. The mind manifests itself in the ways we call perceiving, remembering, judging, etc. It is the sum of all these processes. There should be brought out the close relations of mind and body with evidence that the mind may influence the body and the body the mind.

All phases of psychology are not of equal importance from a pedagogical standpoint. There is needed, therefore, a proper perspective on the part of the teacher, that the right emphasis be given. Difficult topics, such as the psychophysic law, and disputed questions like the existence of pain nerves, may be either omitted entirely or touched lightly. On the other hand, without minimizing the value of some topics, it is certainly correct pedagogy to stress others.

Under sensation and perception bring out the part that sense experience plays in the development of the child and the need of large opportunity for the acquisition of sense material. Training in careful habits of observation will result in usuable memory-images, whereas the lack of clear-cut perceptions seems to result in hampering mental efficiency all one's days.

Give large place to the study of attention and its relation to other mental processes. Note that the key to an understanding of attention, and apperception also, is found in the study of the natural and acquired tendencies of the nervous system. The focal character of attention and the fact that it is a question of more or less consciousness can be easily brought out by simple illustrations. Children are never really inattentive. The teacher's problem lies in securing their attention to the right things, in gaining for the relatively uninteresting ideas of the school subjects a proportionate share of the child's conscious energy in competition with the large mass of ideas instinctively appealing to him. In the early years only passive attention is possible. It is unnatural for the child to hold to long-continued tasks, and the teacher will show his art in graduating the burden to the increasing power of the child. Bring out the relation of attention to will. When children are trained to do the tasks of the schoolroom, we say, and rightly, that their wills are being developed, but this manifests itself as an increase of power to give active attention. The school, perhaps even more than the home, furnishes the means for training the will, for giving the ability to make a sustained effort. This, of course, is the larger part of its function. Perhaps as important as anything in psychology is a right view of the will or action side of consciousness. Consciousness is a motor. All ideas tend to result in action. In the young child action on impulse is the type, but out of his sense experience, and as a result of the trial and error method of learning, inhibition, self-control and power of direction are acquired.

In dealing with the concept, judgment and reasoning it seems best to begin with the relatively simple cases of sense-discrimination and associational reasoning characteristic of animals and young children. Show also that while human thought progresses by a sort of inductive-deductive combination, induction in the teaching of children should receive far more attention than it has in the past, as representing more nearly the way the mind of the child works in contact with his objective world.

Perhaps, for the outlook it gives, more time and attention should be devoted to insuring an adequate knowledge of instinct than any other branch of the subject. Life, and especially child life, is largely lived on the level of instinct. In great measure, the child in his development does repeat the history of the race. He has many instincts and natural interests which may be made useful in his development. The collecting or acquisitive impulse is one of these. The possibilities of play in education are far greater than are dreamed of by the uninstructed. There are a host of social instincts, such as imitation and suggestion, the acquiring of language, the gang instinct, rivalry, etc., which must be reckoned with in a scheme of education, for instincts are in one sense interests and have impelling power to sway the child for good or ill. Again, no truer insight into child life may be gained than by a study of his egoistic impulses. It is here we reach a basis for dealing with questions of a disciplinary character.

These few hints may serve to show the direction such a course as is here contemplated by this Board may properly take.

These texts are among the best: Titchener's Psychology, Macmillan & Co.; Thorndyke's Elements of Psychology, A. G. Seiler; Angell's Psychology, Henry Holt & Co.; James' Talks to Teachers and General Psychology, Henry Holt & Co.; Judd's Psychology, Scribners; Witmer's Analytical Psychology, Ginn & Co.

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